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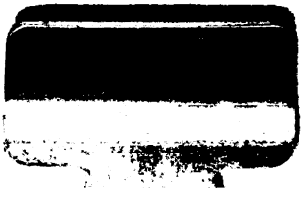

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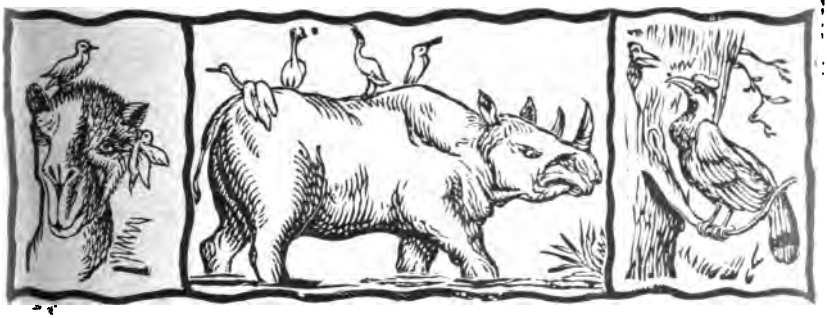

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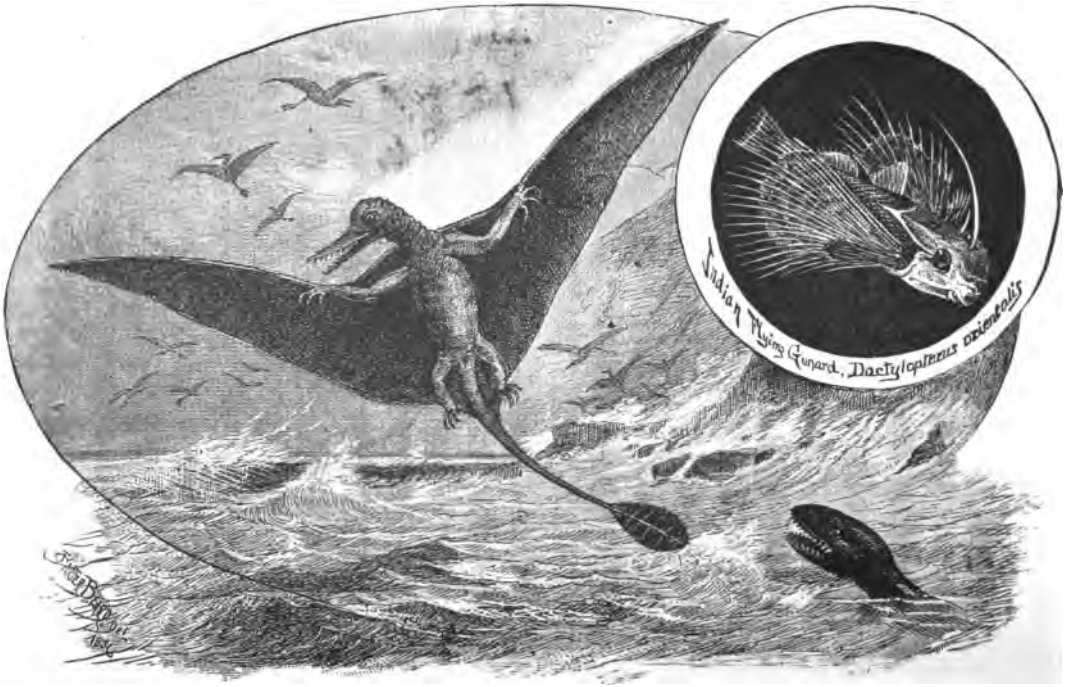

RESTORATION OF THE EXTINCT RHAMPHORHYNCHUS, FROM SKELETON IN YALE COLLEGE MUSEUM.

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WONDER-WINGS, MULLINGONGS, COLOSSI, ETC

BY

CHARLES FREDERICK HOLDER

Author of

THE IVORY KING, LIVING LIGHTS, MARVELS OF ANIMAL LIFE, ELEMENTS OF ZOOLOGY, A FROZEN DRAGON, AND OTHERS

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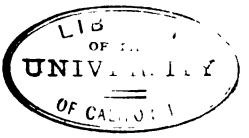

PREFACE.

THE following chapters are presented with the hope that they may arouse an interest among young people in Natural History, or give an additional zest to original investigation among those who are already students in the great out-door school of nature.

C. F. H.

PASADENA, LOS ANGELES CO., CAL.
March, 1888.

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CHAPTER I.

WONDERFUL FLIERS.

THE DRACO VOLANS.

SOME astronomers assume that the planet Mars is inhabited, there being many reasons for believing this, and that owing to the difference in the force of gravity its people can jump over a house as easily as we make an ordinary leap; hence it is supposed that life in the

air is the rule on Mars, and that the majority of forms there are provided with wings, or else with some substitute adapting them to what would appear to us a very curious condition of things.

Some of the animals which people our own planet have hollow bones, and numerous air-sacs, and the weight of their bodies is reduced to the minimum, so that they leap into the air with ease, their fore-arms being modified to suit aerial progress. Such are our birds; and there are many other animals which to a greater or less degree are fliers, though moving by different means.

Some of the earliest and most remarkable fliers were not birds, but reptiles; huge creatures, stupendous and uncanny. It has been known for many years that such fliers existed in the early geologic days; but only within a short time has it been understood that they attained such gigantic dimensions. Skeletons of Pterodactyls, as these flying reptiles are called, are to be seen in many European collections, and terrible creatures they must have been, their jaws armed with sharp teeth; but through the exertions of Professor

Marsh, of Yale College, vast numbers of allied forms have been discovered in our Western country, which range in size from a snipe up to gigantic fliers having a spread of wings twenty-two feet! These aerial creatures differed from the Old World forms in not possessing teeth; they probably relied upon their immense size to terrify their enemies.

The scene in North America, in these days, can perhaps be imagined. Flocks of these strange bat-like animals with long extended jaws, and enormous leathery wings, gathered about the lakes of the time, and undoubtedly dashed into the clear waters in search of prey. When a flock left their roosts and soared away, they must have darkened the earth and terrified the human hunter, did he then exist. A dozen, each with a spread of twenty-two feet, flying together, must have presented a formidable spectacle, and few animals then living but would have been alarmed at their approach.

While the Old World can boast of no flier as large as our Pteranodon, it had some which were

when it attempted to get out; thus showing an intuition which is remarkable; and that it is not sight is shown by a series of experiments which were made some years ago, in which blind bats were released in a room across which cords had been stretched, and which they did not touch in their passage.

One of the most remarkable and interesting of the mammalial fliers is the flying fox, so common in some of the islands of the extreme East. It has a fox-like head, sharp teeth which it uses in eating fruit, and is such a great pest that in some places nets have to be placed over fruit-trees. These creatures hang to the limbs of trees like bats, and in this position would be taken by strangers for the fruit of the tree, so much do they resemble it.

From these animals which have a wing-like membrane stretched from elongated fingers, we may pass to a group which move through the air by means of a parachute-like arrangement — a membrane which hangs loosely when the animal is at rest, but when the limbs are extended, forms a veritable parachute,

connecting the space from the wrist of the fore-limbs to the ankle of the hind ones. Our common flying squirrel is a familiar example, and in the East there are many large and interesting forms illustrating this curious modification, which adapts the little creatures to a semi-aerial life.

The motion of these so-called flying squirrels is not a true flight, but rather the action of a parachute, as they cannot raise themselves in mid-air, and the movement is a downward one. They ascend to the tops of trees, and boldly hurl themselves into space, instinctively holding out the claws which spreads the membranous parachute to the breeze. Thus buoyed up they glide downward, then up a few feet, alighting upon the tree which was the object of the flight; then quickly mounting it to again hurl themselves down. In this way long journeys are made with remarkable celerity, and in some of the large Eastern forms flights of one hundred feet and more have been noticed. Even large streams are crossed in this way; and that it is possible for these living parachutes to change their direction is shown by an incident which occurred aboard a ves-

sel where a pet flying squirrel or taguan (*Pteromys petanrista*) made a leap from the top mast to the deck. At the same moment the ship rolled heavily, and the passengers expected to see the little animal alight in the water; but to their surprise it turned itself by a convulsive movement and sailed down gently to the deck where it was secured.

A very remarkable flier is found in the islands of the East Indian archipelago, and is known as the flying lemur or Galeopithecus. Not only are its limbs connected by a membrane, but a part of the tail is also included, as in the bats. The side membranes are exceedingly large, and the animal can take a long leap from tree to tree, not only passing safely, but also carrying its little ones, which cling to it, and when the mother walks about find ample concealment in the folds.

Very similar in its methods of flight is the beautiful lizard, called the *Draco volans*, or flying draco.

This charming little creature, which resembles in the air some brilliant butterfly or gorgeous insect of the East, is only about a foot long, and

has a web-like arrangement on each side which is boomed out when occasion requires, or supported by bones called false ribs. Like the flying squirrel it darts to the summit of lofty trees, and boldly launches itself, sailing gently down, supported by the curious parachutes which so act against gravity that it generally alights at the selected place with the greatest ease. The parachutes are not in any sense used as wings; that is, there is no motion up and down, though the draco takes extraordinary leaps into the air after insect prey.

The appearance of a group of these lizards moving through the air is indescribably brilliant. Their color is a rich pale blue on the back, other parts being a bluish-gray, while the back and tail are ornamented with many transverse dark bands. The so-called wings, which are of course very prominent when the animal is moving, are marked in black, white and brown, and bordered with a white line. Many different species are known, some of them being disagreeable in their aspect; and undoubtedly from them the old writers obtained their inspiration when describing the drag-

ons which the brave knight had to conquer before he released the beautiful maiden.

Among the swimming birds we notice that the toes are connected by a web which presents a broad flat surface to the water, open only when the foot is pushed back. It would not do to assume from this that all animals with webbed toes were swimmers, as we find in the island of Borneo a little tree-toad, whose toes are connected by webs, so that each foot is a parachute, supporting the creature in its flights from tree to tree. This curious flier was discovered by the naturalist Wallace. He was walking through the forest when one of his men noticed a curious object sailing down through the air and secured it, when the naturalist found to his amazement that it was a veritable flying-toad, which used its webbed feet as wings to transport itself from one tree to another. This animal, though a small delicate creature, has a very long name, *Rhacophorus volans.*

Some years ago a party of gentlemen were sitting in the cabin of a vessel bound for Cuba. They had passed Cape Florida, and were speed-

ing through the warm waters of the Gulf Stream, which finds an outlet between Cuba and Key West. The party were gathered about a table, one of them reading a newspaper, when with a crash and a splutter a strange body darted through it, passing by his face, and fell with a thud upon the floor. It is needless to say that the gentlemen started to their feet in astonishment, and it was not lessened when the victim held up his torn paper, and a moment later picked up from the floor a fish about six inches long, with long pectoral or side fins, and a hard-armored head. The fish was the well-known flying gurnard, common in Southern seas, and had either been attracted by the light, or had accidentally dashed through the open port.

I have often watched these beautiful creatures darting over the waters of the Mexican Gulf. Particularly where the great patches of sea-weed congregate they are numerous, and as they are richly colored, blue, purple, red, and yellow, and marbled with striking spots and bands of darker hue, they are the veritable birds of this ocean summerland.

We do not wonder that they can fly when we examine their fins, as the side ones are so elongated that they are comparatively useless in the water, the tail being the motor there. But when alarmed, or in play, they leap from the water, the wing-like fins are spread, and they dart along, using them as parachutes, and attaining remarkable distances. There are several kinds of these fliers, one quite common about New York harbor, probably finding farther east a coûsinship with the quaint and homely gurnards of the New England coast.

The several species of flying fishes proper, Exocetus, are even more remarkable, and take long flights, some that I have observed being certainly one eighth of a mile. They are frequently seen bounding from the waves in schools, and sometimes the wind takes them and they are hurled aboard ships, striking the sails, and falling to the deck. They are beautiful creatures, though different from the gurnards. The latter resemble some gorgeous insect, in their gaudy dress and metallic lustre, while the Exocetus has a garb of shining silver, with a bluish tint upon the back,

and the extended wings or pectoral fins, which are without color, look like lace.

No question to-day is discussed more widely than that as to whether the flying fish is an actual flier or not, and an army of observers is arrayed on either side. I have seen great numbers of them in Southern waters, and consider that their flight is comparable to that of other animals which use parachutes. The specimens which I have observed in confinement rarely employed fins, or so-called wings, under water, the tail being the principal motive power; and I think that when leaving their native element they probably acquire great momentum by a vigorous movement of this organ. I noticed that when once above the surface, the broad fins, extended to their utmost, were held at such an angle that they presented a slight resistance, the rush of air tending to press them up, and I concluded that when the momentum was exhausted this upward pressure became relaxed, and naturally the fish fell back into the sea. When the wind is favorable the flights, as I have said, are extremely long. Many observers state that

they have seen the fins moved up and down; but I am inclined to think that this was simply the fluttering of the wings as they moved quickly through the air. The advocates of this flying theory are, I think, as a rule, those who have not examined the muscular development of the flying fish which seems totally inadequate to produce such movement.

While in no sense fliers, there are a number of fishes which have a peculiar habit of leaping great distances out of their natural element, and skimming along over the surface. Among these might be mentioned the gars, and in the Gulf of Mexico I have seen them dart from the water, and move incredible distances by merely touching it. In the South Pacific these fishes, or their allies, attain a large size, and this habit is then a dangerous one to the fishermen. A man-of-war's crew were rowing ashore once in this vicinity, when one of these fishes darted from the water, striking the hat of an officer, and knocking it from his head. Natives are sometimes killed in this way when searching after shells on the reef. They

alarm the fishes, which bound away blindly, the sharp arrow-like beak penetrating the person like an arrow. A friend who generally spends his winters in Southern Florida related to me a curious experience which he had in one of the inlets. The yacht was moving slowly along up a stream which was quite narrow, and was seen to be driving a school of fish before it. Soon one of them, a pompino, left the water, and with a bound cleared the rail, and striking the mainsail landed upon the deck. This seemed to be the signal for others, for they now began to leave the water in great numbers, darting in every direction. In short, the yacht was bombarded with pompinoes, which flew over it and upon the decks in such numbers that the men were glad to take refuge behind the rail or dodge when they saw them coming.

The true fliers are, of course, the birds. In their entire structure, the hollow bones, the air-sacs, and feathers, we see an adaptation to a true aerial existence, and in some, as the eagle, the condor and others, the power of sustained flight

reaches its greatest perfection. The birds which spend most of the time in the air make the least exertion. In other words, they depend almost entirely upon soaring, and do not expend their strength upon a continued flapping of the wings. I noticed this particularly among the mountains in Southern California where buzzards are common, and I have seen these birds under the glass and near at hand moving about, rising and falling, now swooping into the cañons, then rising to great heights by circling, without a single movement of the wing, the fore-limbs being perfectly rigid. This was most successful when there was a breeze; but it seemed possible at any time, and it was rarely that a buzzard could be seen moving its wings unless near the ground; the motion while in the air being produced by pitching down or turning the body to either side. I have seen the man-of-war birds remain motionless in the air, four hundred feet up, during a gale of wind, and with wings outstretched they would literally rest on the wind; remaining in the same position a long time, there evidently being an enjoyment in

it, their only movement as observed from the top of a lighthouse, over which they were poising, being an occasional pitching down and subsequent rising. The bird might be compared to a kite, gravity being the string. The gale strikes its breast, and tends to blow the bird before it; but by pitching down slightly it overcomes this, and so remains stationary. This explanation may not be accepted by my mathematical or philosophical readers, but there seems to be no other.

Many young people would probably be astonished if told that air is not the only element in which flying can be practised. Flying under water is not only a possibility but a fact, and the water ouzel is one of the most interesting of all birds in this respect. Most of the water birds are fitted with appliances adapting them for a marine life; but the water ouzel seems to have been neglected, as it has no webbed feet, and is as little prepared for a dive as a robin; yet this does not deter it from taking submarine voyages. It is generally found along the banks of rocky streams, and, curiously enough, seems to prefer to seek its

food under water, boldly plunging in; and once under it actually flies along, moving its wings in the water just as it does in the air. In this way the little flier proceeds along the bottom, now flying, now walking, hunting for the worms and shells which constitute its food.

The penguins have rudimentary wings which appear like fins, and are used as such; the illusion being still farther carried out by the feathers which are so small that they might readily pass for the scales of fishes. These birds spend a greater part of their time in the ocean, and in their movements under water greatly resemble fishes. They cannot fly in the air, but they have wings perfectly adapted for submarine flying, and assisted by their powerful webbed feet they dart along with surprising speed.

There are many wonderful fliers among birds. One in very early times had a tail almost as remarkable as that of the Rhamphorhynchus. It was a reptilian bird, and perhaps had teeth like some curious-toothed birds discovered by Professor Marsh in our Western country. Its tail

was nearly as long as the entire body, and was not of feathers, as in the peacock, but of bone, as in the squirrels, and if we take the tail of our common flying squirrel and imagine feathers instead of the hairs which grow out on either side at right angles, we may form some idea of the appearance of the caudal extremity of the archæopteryx, as this ancient Oolitic bird was called.

In Southern California, in February and March, the sandhill cranes begin to migrate north. They are heavy birds, and I could not but notice their method of saving labor and fatigue in the long flight. They literally "slid down hill" in the following way: Las Casitas, the point of observation, was on the slope of the Sierra Madres, above the foot of the range. The birds evidently left the coast opposite Santa Ana Mountain, some distance below the former place, and there followed the range up north, and I should judge that in six weeks one hundred thousand passed overhead, and as I knew the elevation, they were, at their highest altitude, a mile and a half and sometimes two miles above the sea. Their notes even at

this distance could be distinctly heard. On they would come; the flock of from one hundred to three hundred in a V or other fantastic shape; as a rule, moving at a slight angle downward, holding their wings rigid, and travelling at a rate of a mile in seventy seconds. This downward motion would bring them within rifle-shot of the valley, about once in five miles, and then the flock would stop, and amid a loud chorus of calls begin what was literally a climbing up hill manœuvre, wheeling and circling round and round for ten to twenty minutes, during which the flock gradually mounted upward, high above the tallest snow bank of the Sierras. As they circled higher and higher their white wings would glisten like silver stars from a rocket, now disappearing, now flashing in the sunlight. When far above the range they would again assume the order of flight and bear away down hill to the north. This movement was repeated again and again until their summer home was reached, many hundred miles away.

CHAPTER II.

THE BIRDS OF THE SEA.

THE CLIMBING PERCH.

EVEN ordinary observers have remarked the resemblance of fishes to birds which is so marked that they are even named after them; as the snipe and parrot fishes. It is in the southern waters, "in gulfs enchanted, where the siren sings, and coral reefs lie bare," that these striking similarities can best be seen.

There the water is clear as crystal, so that that small objects can be observed distinctly fifty or sixty feet from the surface; and in shallow

water, from ten to twelve feet in depth, the inhabitants seem exhibited as in an aquarium.

In the summer months in the tropics there are days when not a breath of wind disturbs the glass-like surface of the ocean, and the only sounds are the occasional splash of a fish, the heavy plunge of a pelican, or the victorious "ha, ha!" of the laughing gull. On such days I have drifted over the great coral reefs, with my face a few inches from the water, watching the movements of the finny bird-like forms below. Some poise lightly in mid-water, casting their eyes up, and even moving forward to see what the dark shadow is above, while others lurk in the lanes among the coral branches.

Among the most attractive and curious forms are the parrot-fishes; so called because instead of having small teeth, which we see in other fishes, their entire dental apparatus seems to have been fused together, forming a hard and large pair of bills, or mandibles, calling to mind the beaks of a parrot. With this pair of nippers the parrot-fishes can crunch the ends of branch coral, bite through large shells to obtain the soft interior, and prey

upon various animals which are safe from the attacks of ordinary fishes. In their coloring they also vie with the gorgeous parrots, and as in the large macaws the effect is startling. Some are all blue; others have a variety of colors, blue, brown, and green, arranged in stripes or in remarkable designs. The parrot-fishes are found in nearly all tropical seas, and are recognized by their brilliant decorations. Their method of swimming is also peculiar. The tail-fin, though powerful and broad, is not much used except when the fish are startled or alarmed. When swimming along, the side or pectoral fins are almost entirely used, producing a peculiar, even, gliding motion.

We know that some land birds often take to the water, the duck, penguin, and ouzel being examples; so the "birds of the sea" sometimes venture upon land. The majority of fishes make such protests when taken from the water, and so soon die, that it is difficult to understand how a fish would willingly thus jeopardize its life; but it must be remembered that it is only certain families of fishes which do it, just as with the birds. A robin or

sparrow would be drowned quickly in the centre of a pond, while a duck would be perfectly at home. So a stickleback would die if placed on land, while some of the gobies would not mind it in the least; having with various other fishes certain modifications of structure that enable them to exist out of their native element.

This modification consists of a set or series of cavities that are no more or less than air-store-houses, and do not hold water, as is sometimes stated. In other words, when on shore these fishes breathe air directly, and when in the water obtain it from that liquid.

The best-known of the amphibious fishes is the climbing perch, which was discovered many years ago by the naturalist Daldorf in India climbing a tree. The movements of these fishes on land are extremely slow, the side and lower fins being the organs of locomotion; by moving them alternately and with great deliberation it proceeds slowly along.

The natives of India have long been familiar with this peculiarity of the perch, or Anabas, and

they esteem them greatly for the market, as they can be carried for two or three days in a dry basket without injury. Undoubtedly the object of their leaving the water is to avoid the drouth that prevails in India at certain seasons when the water supply fails. Evaporation soon changes the pools into dry baked mud; and at the first intimation of this these fishes bestir themselves, and often a wonderful scene is beheld; thousands of fishes crawling up out of the pools and in a solid phalanx struggling over the grass, and by some wonderful instinct heading for distant water. At this time they are subjected to many dangers. They are particularly defenceless, and various predatory animals prey upon them; while if the struggling throng is observed by a passing native baskets and other vessels are brought, and the unfortunates shovelled and thrown in without ceremony.

There are fishes which crawl upon dry land to feed, as the ouzel or duck takes to the water for food. These wonderful creatures are found in the Fiji Islands and on various shores of that latitude, and are known as the Boleophthalmus and Peri-

ophthalmus. These long-named fishes themselves are quite small, being only five or six inches in length, with large heads, prominent curious, movable eyes, and colored a deep olive hue. I know several gentlemen who have seen these quaint amphibians hopping about on dry land, but the most remarkable account was given me by Col. Nicholas Pike, an enthusiastic naturalist, and late consul at the island of Mauritius, where he obtained many valuable specimens. In his walks upon the beach he often saw the Periophthalmi, but they were too nimble for him to catch; so he adopted the novel method of gunning for the fishes, taking those which he desired for specimens with a rifle.

The gobies of the Mauritius and Fiji Islands spend half their time out of water; crawling along by using their powerful arm-like side or pectoral fins. Once upon the beach they progress by leaping, and when stationary rest with the head elevated, ready to jump like a frog at the slightest warning. The rapidity of their movements may be imagined from the fact that it is difficult for a

man to capture them. They feed upon various small crustaceans found upon the beach.

In our own country we find several fishes which leave the water. Even our common eels have been seen wandering over low flats near their ponds. Various reasons have been given to explain this unfishlike proceeding, but it is my opinion that they only go upon dry land when forced to for some reason unknown.

On our southern border, on the coast of Texas, an interesting fish is found named *Gobius soporator*, which is the most persistent little fellow imaginable. When several are caught and placed in a pail or vessel, they immediately proceed to escape. Their lower fins are powerful, and by using them they crawl up the sides of their prison, and make their way back to the water.

Some of the fishes allied to the Anabas have such a habit of climbing that (according to Mr. E. A. Leyard) in a Singalese river, the fish were kept in enclosures, covered with matting because they persisted in climbing out.

The presence of fish underground is another

surprising fact. In Gambia a fish called the Protopterus, descends in the dry time and remains in the mud of the banks until the water rises or returns. The natives in many parts of India literally mine for the torpid fishes which thus sleep away the dry season. An English officer reports watching the natives of Kottiar dig out fishes with shovels on the banks of the Vergel River. A shovelful of firm clay was lifted up and dropped heavily, when the fish, which were from eight to twelve inches in length, would be disclosed, extremely lively as soon as the sunlight struck them. Some of these fishes were found a foot and a half from the surface.

We find other fishes living in hot water. At Kannea, near the bay of Trincomalie, are some interesting hot springs whose temperature varies at different seasons from 85° to 115°. When at the latter temperature several fishes were caught — a loche (*Corbetis thermalis*) and a carp (*Nuria thermoicos*) were also taken in this spring where the thermometer indicated 114° Fahr. and a roach when it denoted 122° Fahr. Another spring at

Pooree, with a temperature of 112° Fahr. also afforded fish, and at Manilla when the temperature was 187°; while Humboldt records having seen live fishes thrown from a volcano in South America, the water about them being 210°, or two degrees below the boiling point. Whether they were living in water of this temperature previous to being ejected was of course impossible to determine; the probability is that they came from a cooler subterranean river.

The birds of the air are more or less at the mercy of the wind. During their migrations they are blown long distances out to sea and are lost. Almost every outgoing steamer forms a haven of rest for many lost land birds. Remarkable instances show that the "birds of the sea" are also the sport of the wind. Some years ago a party were travelling upon elephants in India, and when near the town of Kallywar they were overtaken by a terrific storm. It being in the month of July, the time for floods, they were afraid to camp, and pressed on until they reached the neighborhood of Rajkote. But the storm grew more severe,

almost blinding, and all at once the travellers became aware that something besides rain was descending. Heavy objects were falling; and to their astonishment they found themselves a moment later in a veritable shower of fishes; living ones, too, that fell upon them and the elephants in great numbers, sliding off into the grass, and presenting a curious spectacle.

The wind is the secret of the fish-shower. Large bodies of fishes in shallow water are caught up by a passing whirlwind, borne high into the air, and blown along with the gale, finally being precipitated on to tracts perhaps miles distant from the locality from which they were taken up.

In almost every country such occurrences have been recorded. Some years ago a British regiment stationed at Meerut, India, was out at drill when fishes began to fall, and were caught in great numbers by the men and officers who were much astonished at the sight. A short time later another shower occurred at Moradabad, the fish, a cyprinus, coming down in quantities. A shower which fell in the Deccah-zillah, India, was ob-

Shower of Fish in India

served before the fishes fell; the spectators thinking the dark objects in the air flocks of birds. The fishes soon began to descend, and in some instances were quite large. The singular feature was that while there was a drizzle there was no storm. The fish had evidently been carried by a powerful upper current. All were dead, and some gave evidence of having been so for some time, being mutilated; as if they had been precipitated to the earth and caught up several times. In some cases the fishes have been found alive; having been whisked up so quickly and deposited so gently that they were not injured. Such a shower fell in 1839, not far from Calcutta. The fish were about three inches in length, and when the storm had ceased they were found pattering and frisking about on the grass. These did not fall promiscuously, but in a continuous straight line not more than a span in breadth. The distances to which fishes are sometimes carried seems almost incredible; but generally they are precipitated a mile or so from their native pond or stream.

To return to our comparisons between the birds and fishes, we find that the latter are also nest-builders. True, the fish-mothers that display solicitude for their young can be counted on the fingers. But if the mothers lack this care, the fish-fathers have an unusual amount, and assume family responsibilities. In their constructive ability, or the instinct which prompts them to erect homes, we see striking resemblances to the birds. The long nest in the gravel of the salmon, or the smaller one of the trout or sun-fish well compares with the sand hollow of the gull, while the shapely structure of the robin or sparrow finds a prototype in the nest of the stickleback, the officious, bombastic inhabitant of the streams of both continents.

It is the male stickleback that cares for the coming young. As the season approaches he assumes a gorgeous garb of pink or red. Now if we have the little nest-builder in an aquarium let us drop a napkin ring into the water, suspending it from a string. He dashes at it, biting it with ferocity until he is sure it is not an enemy;

then the strange object is carefully examined. If we have attached threads or bits of grass to the ring, and the rest of the aquarium is not provided with them, the chances are that he will adopt the ring as the foundation of the future nest, reminding us of the wren, that is seen at the nesting season examining the nooks and corners about the yard. Presently we see him (presuming him to be the *Apeltes quadracus*) devoting great attention to the grass or threads, nosing them about and pressing his body against them, and if we could approach close enough we should see that he is binding the threads or material together with a delicate silvery thread issuing from a minute pore in the lower portion of his body.

Now other threads and grass should be thrown into the aquarium, just as you provide the tame weaver-birds with string. These the little stickleback will collect and pile upon the nest within the pendant ring, until finally the nest assumes shape, half or entirely filling the ring. In the final touches, the little builder reminds us of a bobbin; indeed his shape is not unlike one, as into the

nest he darts head-first, repeating the operation indefinitely until he wriggles through, then we have a ring within a ring.

Next the mother-fish is hunted up and driven to the nest, and there in the little cavity the eggs are laid. Over them the patient father now takes his stand, holding himself steadily in position, and fanning them gently with a vibratory motion of his fins, thus producing the requisite aeration. If he was pugnacious at first he now is positively mad; darting at everything that can be possibly considered an enemy. Place a hand against the glass, and the thud of his sharp nose is heard in a vain effort to get through. If other fishes happen to be in the tank it is best for them to keep a safe distance, for no matter how large, the proud stickleback-father darts at them, inflicting dangerous wounds with his sharp dagger-like spines, and soon putting them to flight.

Finally this careful watchfulness is repaid by the appearance of the little ones, which the sharpest eyes are necessary to distinguish. Now the father's attentions are redoubled, and every mo-

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ment is taken up in preventing the baby sticklebacks from straying. I have seen him dart at the straggling little ones, draw them into his mouth, and then violently expel or shoot them in the direction of the nest. But the older they grow the farther they wander, and finally the distracted parent gives it up and deserts them, and the nest soon becomes a moss-covered ruin, the resort of shells and other quiet loving creatures.

There are several species of sticklebacks in this country and Europe; some large, and others small, and they are far more interesting for the aquarium than the solemn gold fish, whose only attributes are its beauty and the fact that it is the everlasting among fishes, sometimes attaining the age of a century.

While the resemblance is perhaps not a strict one, the nest of the little South American Serrasalmo calls to mind the swinging home of the oriole. The rivers of South America are often lined with a dense growth of verdure. Palms and other tropical trees often bend far over the water, casting a welcome shade for the fishes. These palms

are sometimes encircled and connected by innumerable vines, or *lianes*, which wind in and out, binding the vast forests in a perfect maze. As the vines climb the palms and reach out, they continue to grow until they drop down in long ropes into the water. The end which dangles in the current throws out numerous shoots and roots, which soon form the lodging place of floating matter from up stream, so that in the course of time we see attached to the vine a miniature island blooming with flowers grown from seeds that in turn throw out roots themselves. This arbor catches the eye of the little fish, and is converted into a nest and nursery. In among the roots of the floating bower the eggs are laid, the parent fish taking its position beneath to guard the spot. When the young appear they find refuge for some time among the roots and stems, where no other fish would suspect their presence.

In the East there is a remarkable bird called the Megapodius, which heaps up enormons piles of material in which its eggs are deposited. Some of the penguins and other water birds roll pebbles

and stones together as a protection for their eggs. Is there not a finny bird of the sea or river that has a similar habit? I made the acquaintance of such an one a few years ago on the beautiful St. Lawrence. In rowing along in the little bay in the southern portion of Westminster Island I noticed on the right hand side of the rift a pile of pebbles and stones that must have been nearly a cartful. They looked as if a tip cart had backed and dumped them on the edge of the little channel for some definite purpose. So artificial was it in appearance that we concluded it was a lot of clinkers which had been thrown from a steamer or that some small boat had here cast over a load of ballast. Several days later in rowing along shore just at the entrance of the Lake of the Isles, opposite Westminster Park, I came upon three or four similar heaps, in shoal water. One of them was about ten feet in circumference and three or four feet high, approaching to within a foot of the surface, so that I readily reached some of the top pebbles. There were thousands of stones, and I estimated that the largest heap

must have weighed nearly a ton, some of the stones that I secured weighing two ounces, while others at the bottom were nearly twice as large.

These curious heaps were the nests of fishes, and along the sandy and gravelly shores of the Thousand Islands I found many more, telling of the perseverance and industry of the builders.

These nests are known to the St. Lawrence oarsmen as "chub heaps," and the chub, or scientifically *Semotilus bularis*, is the builder. I was fortunate in finding the nests in all stages of construction, from a mere outline to the complete nest that undoubtedly took several seasons to build. The newly begun nests *seemed* to show a plan of construction; thus the stones were dropped in a rude circle at first, as if the finny architects outlined the work before carrying out the design. The nest is made by one or more chubs, each stone being brought in the mouth and dropped in the selected place until it assumes large proportions, the pile sometimes being high enough to stop a boat. How such a heap of stones can be used as a nest would seem an

enigma, but the rocky castle contains innumerable nooks, corners and crevices in which the eggs and young find refuge from the cat fish, perch, and other forms which prey upon them; the eggs being deposited on the nest, the current washing them into the various "snug harbors."

The class of fishes which resemble the robins and thrushes in the construction of their nests, may be still further illustrated by a quaint little fish known as the Antennarius, which is found floating in the great masses of sargassum or gulf weed of Southern waters. Their nests are composed of the weed among which they lie, and when complete resembles a small football. The fish so mimics the weed in color, and indeed shape, that I have had them drifting under my eyes for several moments without distinguishing them. As a rule, they lie in the thickest part of the weed upon their sides, and when swimming upright present a curious appearance, some species seeming to have actual limbs; indeed one species is called the walking-fish. The nest is made by taking bits of weed in its mouth and collecting them together,

binding them in the desired shape with gelatinous threads probably taken from some pore, as in the case of the stickleback. Be this as it may the ball is held closely together, and the minute white eggs are attached to the leaves and various parts, and in the lanes and cavities of the interior the young find security.

Among the interesting nest-builders of Eastern waters is a slender fresh-water fish known as the Ophiocephalus. It collects bits of weed and grass and binds them together, among which the eggs are deposited. This fish, like the little stickleback, takes its young in its mouth when danger approaches, and holds them there.

But perhaps the most interesting and bird-like builder is the famous Gourami of the East which sometimes attains a length of five or six feet. At the nesting-time these fishes pair off and join forces in forming a nest, generally utilizing a grass known as *Panicum jumentorum*. As a rule the nest is erected on the bottom, but if the builders are provided with the limb of a tree or a branch the nest will be placed in it, so that in

this respect it has a striking resemblance to that of the birds. The blades of grass are rudely woven in and out, fastened together with mud and in various ways until a solid compact nest is the result, in the interstices of which the eggs find a resting place and the young are ensured protection.

The care and vigilance exhibited by a few parent fishes at this time is remarkable. I noticed one day at the Thousand Islands that a sun-fish had taken up its stand directly in front of the place where I hauled my boat in and pushed it out a number of times a day; but neither the noise nor my presence seemed to trouble it, and when my hand was reached down it merely moved away, assuming a pugnacious attitude by suddenly elevating its dorsal fin just as a cat does her tail; and if the tip of my rod was extended the little guardian would dart at it and actually refuse to be pushed aside. So pugnacious was this fish that it soon attracted the attention of all who came to the boat-house. It invariably poised about three inches from the bottom, its head to

the shore; continually moving its fins in such a way that a current was created that swept the locality clear but did not affect its position. The meaning of all this was that a family of sun-fishes occupied the hollow, and the father was on guard to drive away enemies. The mate, presumably, was not far off, as I often saw it just under the float, but at the slightest advance toward the nest the guardian would rush at it with dorsal erect and, I have no doubt, eyes flashing. Other fishes received the same treatment, and for many days this little sentinel defied both man and fish, only giving up the post when the little ones appeared and strayed away.

In their motions the fishes remind us of the birds. Especially is this noticeable in the rays of the South, where the stingaree and whiparee, as they are there called, are common. These fishes are flat, almost triangular in shape, the pectoral fins being represented by side or lateral prolongations that not only appear like wings, but resemble them in motion. As the stingaree glides along the side fins are seen to move up and

down, and as the upper side is dark, and the lower pure white, each motion seems to cause a flash of light, reminding one of the soaring of certain birds, as the sand hill cranes, which when whirling about and turning back to the sun seem like a galaxy of silvery stars against the sky.

The fishes present the greatest contrast, as do the birds, in their movements. Some are always soaring, or at the surface of the water. Such are the gar-fishes of the South. I have watched scores of them, and had them under observation for many consecutive hours, but never saw one leave the surface beyond several inches in chase of some smaller fish, and then it was to return immediately. They may be compared to the swallows which are nearly always on the wing.

Quite the reverse are the flounders and their allies. Who ever saw one swimming about in open water? One would as soon expect to see a quail or domestic fowl soaring a mile up in the air. They are the ground-birds of the sea, and in all salt-water aquariums the flounder should have a place, not for its beauty, perhaps, though

it has eyes like veritable gems, and capable of the most astonishing movement. But the chief interest about these little flat fishes is that they persist in lying upon their sides, and that nature makes a remarkable attempt to enable them to do so with ease. To understand this thoroughly we should have several flounders, representing different ages — or stages of growth. Taking an infantile one we shall find that it is not disposed to be a flat fish; but swims about after the fashion of fishes in general, not confining itself to the bottom. This continues for some time, until suddenly the fish shows an inclination to sink to the bottom and lie upon its side. This habit seems to grow upon the flounder with astonishing results. For all this time, it must be remembered, the flounder has had the general shape of ordinary fishes, and an eye upon each side; but as this habit of lying down continues to grow, it is evident that one eye must fare badly — not only from being rubbed against the sand, but being deprived of its exercise as an organ of sight. But Nature objects to useless members, and if we watch the little

flounder we shall see wonderful changes. First the mouth is attaining a remarkable twist; then the underneath eye is seen to have altered its position, and, finally, it moves around, so that in the adult flounder as we see it in the market, the eye is quite near the other, both being on one side of the fish and of equal use. The mouth is also twisted to suit the new position. The entire modification as it is termed presents a curious instance of the effect of habit upon animals.

CHAPTER III.

AMONG THE TURTLES.

THE HYDRASPIS.

SPECIMENS of the leather-back turtle, *Sphargis coriacea*, the largest of this interesting group of animals, have been caught which weighed nearly two thousand pounds, and had a length of eight feet. Several have been captured off the New England coast, one at Lynn some years ago, while others have been observed in the Bahama Islands, on the coast of Burmah, and in various localities. In fact, this king of turtles is a great wanderer, having a wide and extended geographical range; yet comparatively little is known of its

habits, except that its home seems in the open sea.

The strength of these huge creatures has been often tested. One that was discovered landing on the banks of the Yé River, in Burmah, several years ago, dragged six men a considerable distance, and would have carried them into the water and escaped, had they not been reinforced; finally the men conquered the animal, which was found to measure over six feet in length. This turtle had probably landed to deposit her eggs.

A number of years ago the inhabitants of a little seaport on the island of Jamaica were greatly excited over the tracks of an enormous turtle found upon the beach one morning. The trail was followed up and a nest found that was four feet deep, and contained five or six dozen eggs. Watch was kept, and a few days later the great turtle was caught about one hundred feet above the water. She hauled ten men some distance, and it finally took twelve lusty fishermen to turn her on her back. She was even larger than the first-mentioned turtle, measuring six feet six inches

in length, and from the tip of one fore-fin across to that of the other nine feet two inches. Specimens eight feet in length have been found, weighing twenty-two hundred pounds, so it is evident that the leather-back may be considered the king of turtles.

The turtles with which we are familiar have, as a rule, definite scales, but the leather-back turtle has a peculiar shell, which is probably the reason many persons believe it to be something else than a turtle. Standing upon its back and looking down, the shell appears to have a depressed top shape; the back is entirely destitute of scales and of a leathery structure, elevated into parallel ridges. The fore-flippers are extremely long and powerful; the bill sharply barbed; the eyes nearly vertical; so that our huge turtle offers quite a contrast to its cousins.

Some interesting features are presented by turtles. They differ greately from all other animals. They are enclosed in a shell, into which many withdraw entirely. If we examine one we see that it has two distinct shells; the upper, or car-

apace, and lower, or plastron, which united form the box or house in which the animal lives. The backbone, or vertebra, is joined firmly to the upper shell, consequently has not the flexibility seen in other animals. The ribs also are immovable, and the carapace, or upper protecting shell, is really formed by the widening of these bones. In the mouth of the turtle we find two horny beaks in the place of teeth so that they nip and crush, instead of cutting their food. Their eyesight is acute, these organs having a third lid, or what is called a nictitating membrane. In America, north of Mexico, we have about forty species of these interesting animals, and they are found in almost every country that will support life.

From their great size, as we have seen, the marine turtles attract the most attention, and ranking next to the leather turtle described are the loggerhead, *Thalassochelys caouana*, green, *Chelonia mydas*, and hawk-bill, *Eretmochelys imbricata*, all more or less important in commerce. These forms are rarely seen north of Florida, and

in the waters of the islands about Bahama and farther south they make their home.

The loggerhead resembles the green turtle, but is larger and more powerful, and ranks far below it as an article of food. In the Gulf of Mexico they frequent Loggerhead Key — an island about a mile long, at the extreme end of the Florida reef. Why the turtles choose this island, among a group of six or seven, is difficult to tell; but the fact remains that in the turtle-season loggerheads land on this Key in great numbers, while certain other Keys are only used by the green turtle. This may not be the rule, but was so nearly so that during a long residence near this island I never found but one loggerhead nest away from Loggerhead Key.

The turtle time in the Southern country is one of considerable activity. Turtle-turning is considered quite a sport, and one involving no little exercise, as I have demonstrated on many a hard-fought field. Two methods of taking turtles are in vogue: one by what is known as the peg, and the other by "turning." In the former the turtler

goes out in a small boat, armed with a long slender polls, upon the end of which is a three-sided peg. This is hurled into a sleeping turtle, suction preventing it from tearing out, at the same time no injury ensuing. The other plan is to watch for the turtles on the beach as they come up to lay, and here the animals have fair play. A moonlight night is selected, and after landing on the Key the boat is concealed if possible, or hauled up so that there will be nothing to alarm the game, as they are wary and suspicious.

The beaches on the Bahama Islands are of pure white sand, made up of coral rock, bits of shell and lime-secreting algæ; so the smallest objects can be seen some distance. The beaches from the water to the bush-line are generally about one hundred feet, and up near the mangroves or bay-cedars, the turtle-hunters take their places, in parties of two or more, about a quarter of a mile apart. I have often joined in these hunts, when sport and pleasure was not always the incentive, as turtle meat took the place of beef, which was not to be had. The nights chosen for this

purpose were perfectly still, not a breath disturbing the glassy surface of the ocean, an occasional cry of some gull upon the reef, the splash of a shark or other large fish, and the musical trill of the water as it broke upon the beach being the only sounds heard. Up near the bush we lay, watching the spirit and soldier crabs while waiting for the moon, for it is a popular superstition among the wreckers and fishermen that the turtles will not rise until the moon appears. Finally a dim nebulous light mysteriously pervades the sky, as if day were returning. Brighter it becomes, and fainter grow the stars. The southern cross fades perceptibly before this new glory, and finally, out of the depths the silvery moon rises, transforming this summerland; chasing away the deep shadows, and converting darkness into light. Now comes the time of action, and soon from each little group a turtler now and then starts rapidly down to the water's edge, and runs swiftly along; looking not for the turtle but for its tracks. On he goes, then suddenly stopping before two irregular parallel lines that lead directly from the water toward

the bush, he gives a whistle, and runs quickly up the trail that brings him to a fine old turtle who has commenced to dig her nest, but now seeing her enemy turns to regain the sea. The finder seizes her by the side, and in attempting to lift her, receives a cloud of sand in the face and is partly thrown over. She is too heavy to manage alone, and makes desperate struggles for liberty. How the sand flies! and how slow the others are in coming! The turtler places himself in front of her, and bars her progress with a stick; but the welcome water is near, and just as she has dragged her enemy to the very edge help comes. Two seize her by one side, while another hauls, pulls, and strains, now all together, and amid the flying sand and vigorous blows from her sharp flippers the turtle is toppled over upon her back helpless, while the captors drop upon the sand to recruit for the next one that may appear. If not too heavy the prize is hauled well above the water, and the party soon resume their positions near the bush, and send out another sentinel. In this way a number of turtles are often caught, and I have

sometimes gone home in the morning with five or six, green and loggerhead. The largest that ever fell to my lot was a loggerhead that resisted three men, and finding that she was taking us into the water one of the party brought a piece of timber which was placed beneath her, and with this as a lever we landed her upon her back. This was an extremely old loggerhead, and totally useless as food.

The turtles as soon as caught are carried to certain fenced enclosures near the shore called "crawls" — places from fifty to one hundred feet in shallow water — where they are kept until required, then shipped in small vessels perhaps to Nassau, and finally to New York.

The "turtle-crawls" are always a source of attraction to the youth of the Bahama and other islands, and when a turtle is to be caught there are many volunteers; this being ranked among the chief sports of the reef. At the word the young turtlers enter the water, and swim cautiously up the crawl. Ordinarily many of the animals will be found asleep on the bottom, only rising occa-

sionally to breathe. Toward the sleeping reptile the young swimmers move, and when sighted they dive quickly, and by a rapid movement the animal is grasped by the shell just over the head. The moment the turtle feels the diver upon its back, its powerful flippers wildly strike the bottom; then rising to the surface, it takes a single breath, and away it goes, towing the rider, now under, now at the surface, in a wild race up the crawl; then turning to dash down again, creating big waves, meeting other riders perhaps on the way, all carried away by the excitement of the chase. In this way I have often been towed for long distances, and can certify to the exciting nature of the sport.

To the uninitiated turtle-riding is not pleasant, as if the animal is a large one it will succeed in keeping its enemy under water at least two thirds of the time, and finally wash or drown him off. The secret of riding is to stretch out behind, grasp the animal's shell as indicated by both hands, and raise the head up, presenting the chest to the water. This movement invariably acts as a rud-

der and forces the turtle to the surface; then the rider can if he wishes lower himself and take a header with the flying animal.

It might be supposed that the animal would resent this treatment; but I never saw one attempt to bite unless teased. The loggerheads have among the fishermen the name of being the most vindictive of the turtles, and certainly look so; but they are huge, helpless creatures, and I have frequently seen them with all four flippers gone, the result of a struggle with sharks.

If the turtles are not disturbed by the hunters when landing, they will crawl up the beach, well above tide water, and then excavate a hole and deposit from seventy-five to one hundred spherical eggs, which are covered with a soft shell feeling like delicate emery paper. In concealing the nest they often exhibit considerable skill, after covering it crawling along the beach some distance and returning to its native element by an entirely different path. That this is confusing I have often appreciated in following up a track two or three days old. Those leading up and down were al-

ways easily distinguished, and about two hundred feet apart; the nest was somewhere between them, but a long hunt with a sharp stick and continued probing would alone enable one to find it. In fourteen or fifteen days the turtle returns to the island and forms another nest.

The eggs are hatched entirely by the sun, and in six weeks time the little loggerheads, or green turtles, as the case may be, will be seen wriggling their way up through the sand, and making their way for the water, where they are preyed upon by various birds and fishes. At this time their shells are soft, and they present a comical appearance, and they then form most attractive pets. I had twenty or thirty such at one time, and their movements on shore, and the remarkable instinct they displayed in finding water was a most interesting study. The green turtle attains a large size, and specimens have been found weighing six hundred pounds.

Among the islands south of Florida is also found the hawk-bill, from which the famous tortoise-shell is taken. Covered with large promi-

ment plates, its flippers long and slender, it darts along with remarkable speed, easily escaping its foes, and rarely being taken except when asleep or surprised. Its name refers to the sharp hawk-like bill that points truly to a carnivorous nature. Crabs, sponges, an occasional physalia, and various other animals constitute its food, while it by no means despises vegetable fare. A pet hawk-bill, which I kept for some time, lived upon land parsley.

In many of the Caribbean Islands the plates of the turtles are taken in an extremely cruel way, and the animals returned to the water to reproduce them. But the finest shell is said to come from the Celebes, where the animals are instantly killed and boiled to remove the shell. The latter is too well known to need mention. Large quantities are used in the manufacture of jewelry of various kinds, combs, etc., and for inlaying fine furniture. The large combs that were in vogue with our grandmothers years ago were made from a single large plate, and were and still are quite valuable.

The fresh-water turtles while very interesting, are much smaller than their ocean-allies, though one is found in South American rivers which attains a width across the back of nearly three feet. In the rivers of Florida I have often caught what is called a soft-shelled turtle, *Aspidonectes ferox*, the upper covering feeling like India rubber, and presenting a clear surface. It is often taken on hooks, and in nets set for fish, and is an extremely active and voracious creature; preying upon small alligators and fishes of various kinds. These turtles are often seen in the market at Jacksonville and other localities, and are esteemed as an article of food.

The true fresh-water turtles of the world belong to the order *Emydidæ*, and are represented in various climes by over sixty species, or different kinds. They differ materially in appearance from the others. They have a more or less depressed shell, though in some cases it is convex. The toes are distinct, and provided with webs, and the limbs are organized so that the turtles can lift themselves some distance from the ground and travel

with considerable speed. The shell is often brilliantly ornamented, and a thorough protection, being made up of horny shields. They are generally found in ponds and streams, resting on logs or sand-bars, while some wander far into the woods in search of food. Their eggs are, as a rule, oblong, and buried, as are those of the marine forms, in the sand alongshore, to be hatched by the sun.

Perhaps the most familiar form is the box-turtle, *Cistudo*, found almost everywhere in the United States east of the Mississippi River. It is independent of the water, and commonly discovered roaming through the woods in search of mushrooms and toadstools. It is particularly interesting from the fact that it can shut itself completely in its house or shell, the plastron having two lids joining like the cover of a box.

The age to which these little creatures attain is somewhat remarkable. A family in New England possessed one upon whose back were the initials of a member of the family five generations back, the carving having been made in the last century. The common Greek tortoise, *Testudo Græca*, so

common in the countries about the Mediterranean Sea, is equally noted in this respect, and I think it is true of the entire order. In Lambeth Palace there is a shell of a Greek tortoise that was placed in the garden of the archbishop in 1633. It was still living in 1753, and then died at the advanced age of one hundred and twenty years; even then, its death was said to have been due to neglect on the part of the gardener.

In the winter all the northern fresh-water turtles retire beneath the surface; some in the mud, others into holes which they excavate in the soil, and there they hibernate until warm weather returns, neither eating nor drinking, all the functions being at a standstill.

While the box-turtle is extremely mild and peaceable in its disposition, the snapping turtle *Chelydra serpentina*, is a veritable bull dog in its nature; striking with its powerful head, clinging to its enemy with persistency, and to show the force of its bite, one has been known to cut through a board an inch thick with its horny jaws.

Though the snapper has a very snake-like head

it is exceeded in this respect by the strange Hydraspis which has a slender neck nearly as long as its shell; so long, in fact, that it does not draw in its head like ordinary turtles, but places it on the side of the body. When these turtles, swimming just under the surface, lift their heads above water to reconnoitre, the observer would consider them snakes. They are confined to the rivers and streams of Brazil where the curious bearded or imbricated turtle, *Chelys matamata*, is found, the most remarkable of the entire tribe. This turtle attains a length of three feet, has a long neck ornamented in a most wonderful manner with barbels and fringes of flesh, so that one can well imagine that it had been overgrown with moss or weed. On each side of the head are two curious prominences that look like ears; above the mouth is a pointed nose-like extension of the skin; add to this a shell resembling rough rock, and we have a creature which certainly must find much protection in its resemblance to moss-covered rocks.

Some remarkable turtles, as regards size, are found on the islands of the Galapagos Archipelago;

these are known as elephant-turtles. There are several species, and when the islands were first discovered they existed in great numbers, but since then many have been killed, and vessels stop there to capture the huge creatures as a marketable commodity. These islands are of volcanic origin, and contain many extinct craters and cones, in and about which a growth of cactus is found. When the original discoverers visited Chatham Islands, they found curious paths leading up to the mounds, winding in and out among the cacti; by following these up they soon came to a number of large springs, in a muddy basin, wallowing in which were scores of monstrous turtles. Some were drinking, while others had evidently just finished and were walking slowly away down the well-travelled paths. When approached they suddenly drew in their legs and dropped with considerable noise, at the same time uttering a loud hiss. Their size and strength can be imagined when it is known that two men could sit on the back of one, the animal carrying them with ease. I have stood upon the back of a young one hardly two

and a half feet long, and the animal moved without difficulty. These huge creatures are very fond of water, and go periodically to the springs, evidently obtaining a supply sufficient to last them some time. Undoubtedly they are not dependent upon it, as on some of the islands no rain falls except during a few weeks, and there are no springs, yet the islands are inhabited by turtles that feed upon the cactus. Beside the hiss that turtles utter these roar loudly at times.

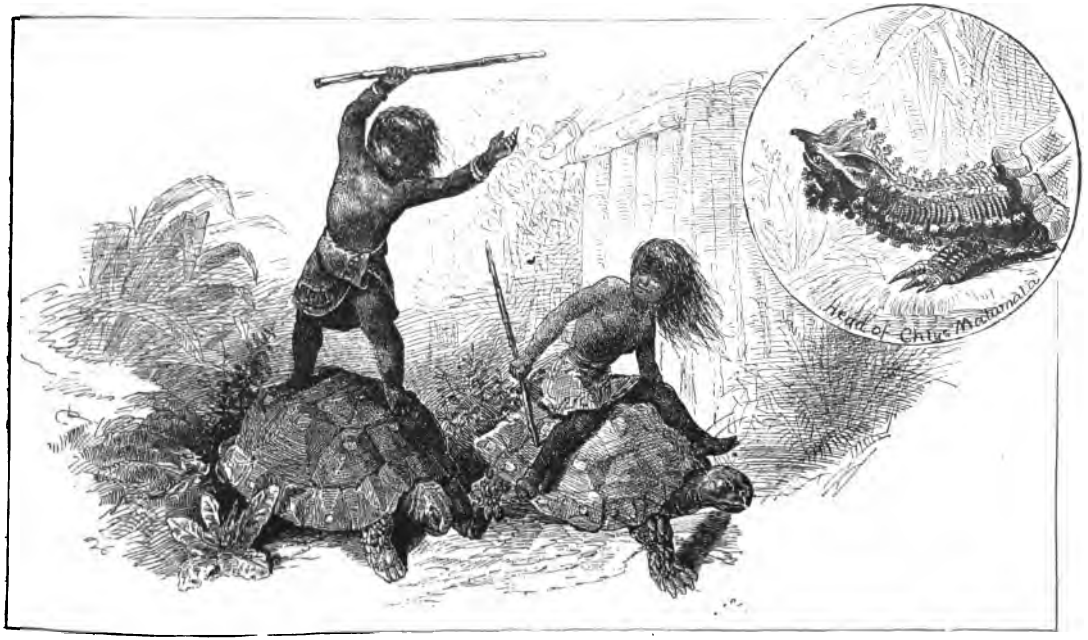
Such great creatures are naturally slow travellers; yet Darwin found by marking specimens that they could travel eight miles in two or three days. He says, "One large tortoise which I watched I found walked at the rate of sixty yards in ten minutes; that is three hundred and sixty in an hour, or four miles a day, allowing a little time for it to eat on the road."

"Some years ago," said a friend, who was a famous traveller, and with whom I was exchanging turtle experiences, "I found myself up the Amazon so far that I imagine I was the only really white man in the country. The natives and half-breed Por-

tuguese held undisputed possession. I was well received everywhere, the people being extremely hospitable, and among the curious things that I noticed was that almost every family kept turtles just as we do pigs. In other words, attached to nearly every little house was a pen or corral in which one or more turtles were confined as the family meat-supply, and killed as occasion required. The turtles, *Podocnemys expansa*, were extremely large, some weighing two hundred and fifty pounds, and were three feet in length, and proportionately stout and bulky. I found that they formed one of the most important articles of diet in the country, and many of the natives earned a living by catching and selling them to the richer people. The dry season was the time for the capture; the animals being kept until the hard times which were supposed to come on during the wet season when the waters were high and overflowed everything.

"My first glimpse at these huge turtles was at a small hut where I observed a child sitting in a bath tub made of the shell of one, and this led to my becoming acquainted with the originals,

for my host observing my interest in the animals told me that a regularly-organized hunt was to take place in a few days, and as his men were going he invited me to join them. On the morning of the hunt we went to a little settlement about five miles up the river, and there waited for the entire party, the members of which were arriving every minute in their canoes in fours and fives. Having some time to wait I went ashore and strolled about, and at one of the houses I found that the turtles in their usefulness were not restricted to food but were utilized by the native children as perambulators. Hearing a shouting in one of the corrals I looked over the fence and there were two little urchins, each mounted on a large turtle, and evidently racing, as each rider sat astride of the shell, and with a piece of bamboo split at the end urged the phlegmatic steeds along at a pace which might have been a mile a week, as the turtles aroused at the noise of the blow, would scramble ahead a foot, for it certainly could not be felt; but the moment their heads protruded far enough to see the diminutive rider



A TURTLE RACE.

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they would take alarm, draw in neck, tail and feet, and stop suddenly to recover courage and repeat the manœuvre a moment later — the riders varying the performance by standing upon the backs of their steeds and frisking about like circus riders.

"I was recalled from this diversion by the captain, and soon a fleet of twenty or thirty canoes was moving up the river. A mile above they turned up a branch, and the water shoaling the canoes were hauled upon the bank at a point of land, and a detour made through the forest until finally one of the men beckoned me to look down through the trees. We were on an elevation of perhaps one hundred feet above the stream, and as I glanced down I saw that it was almost dry, the channel dividing, one branch flowing on one shore, and one on the other, the middle portion being entirely made up of sand banks and shallow stretches of water. These banks originally may have been white, but now they were fairly black with the great turtles which we were in search of. If I had been told beforehand that such a vast number would collect I could hardly have

believed it, but here they were before my eyes, literally covering the flat; not singly, but in piles and heaps, as many as five and six in some cases.

"The men enjoined silence, and proceeded carefully to the water's edge, then dividing; one half, perhaps thirty men, taking a net and going above and around, while the others remained opposite the unsuspicious animals to wait until the other party had reached a spot directly in front of them, the method of procedure being for both parties to advance on the horde from opposite sides of the river carrying the nets, which were ordinary seines, and so prevent the turtles from reaching the water. At a signal both parties crept to the edge and gradually spread up and down stream with the nets, and when the latter were stretched to their entire length word was given and all the men dashed into the shallow water and ran toward the centre or each other. The moment the turtles heard the noise and saw the men, it seemed as though the entire bottom was moving away, as they scrambled in indescribable confusion toward both parties, instinctively knowing that water was in that

direction, while many went up and down; but by far the greatest number ran directly into the two nets that were soon connected at the ends, completely surrounding the reptiles. The men shouted with excitement, dashing after those which crept under, or moving the net to avoid the turtles which piled themselves up against it. But escape was well nigh impossible; they were entrapped, and that, too, without injury, and after many frantic endeavors to reach the adjacent water they seemingly became reconciled to their fate. The men then entered the trap and seizing the turtles tied them up with great skill and rapidity, while others took them out, often two men being required to carry one in the direction of the canoes. Only those of a certain size were retained, all the small ones being released to grow larger and perhaps be caught another year.

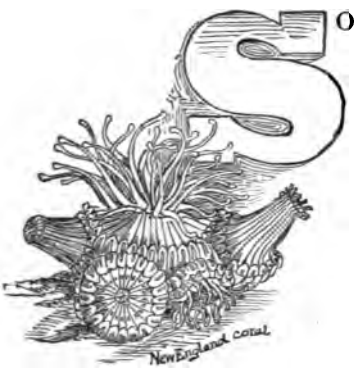
"The entire day was taken up in disposing of the catch, and when night fell the canoes were loaded, many of the men camping on the spot to watch the captives until the return of the boats the next day. In this way the natives secured

their food supply, and the shell was used in many ways, the small ones as dishes, or, fastened to handles, as spoons. In fact, in this great land of the sun the turtle was a very important and valuable feature."

It is generally supposed that turtles are not remarkably intelligent, and this probably is the case. I have had many as pets, including green, loggerhead, hawk-bill and various land turtles, but never could discover that they possessed anything more than cunning in some cases, and intuition in others. As an instance of the latter I placed a dozen small green turtles just from the egg in a room that had a door leading into the water, and though the latter was closed so that the water could not be seen or heard, the little fellows would invariably crawl to the seaside door, no matter in what direction they were turned.

CHAPTER IV.

IN THE CORAL COUNTRY.



SOME NEW ENGLAND CORALS.

SOME years ago a gentleman who was interested in natural history, accepted an invitation to lecture in one of the large Eastern cities. The subject was the corals; and he suggested that as there was a very general misunderstanding as to the nature of these interesting animals he would give particular attention to that part of the subject. The announcement, "A Lecture on Corals, by Professor ——," was given to the secretary of the society for publication, and

before handing it to the printer he corrected what he considered a slight mistake, so the announcement read that Professor —— would lecture upon the "coral insect" — much to that gentleman's indignation, as it was the idea of "the coral insect" that he wished to correct.

The "coral insect" is a growth of several poetic imaginations, and the descriptions of its toiling and building are equally freaks of fancy; so before discussing these animals and their homes let us obtain an idea of the true nature of corals.

While the white, bleached, dead coral is by no means rare, you may not have seen a live coral; though a very beautiful one, *Astrangia*, is found in Long Island Sound and in adjacent localities.

But while not familiar with living corals we may find all along the New England coast a cousin of theirs — the sea-anemone, which will afford us an idea of the coral animal. In any pool at Nahant, or wherever there are rocky shores, we shall find pillar-shaped objects of brown or other hues, varying from two to four inches in height, and in some cases resembling a beautiful flower; the

upper portion spreading out and seemingly divided into myriads of petals often colored with rare and beautiful tints. If we touch this seeming flower it shrivels; the petals draw in, and the living pillar or column seems a brown inconspicuous mound.

This animal is an anemone, or *actinia*, and one of myriads found in nearly all waters, sometimes simple in color, sometimes gorgeous, sometimes scarcely an inch in length, sometimes a giant two feet across.

If now we try to take up this anemone we shall find it a difficult operation; in fact, it adheres to the rock tenaciously. Upon examination we learn that the anemone has a sucking-disk by which it anchors itself. By prying off a specimen and placing in a glass jar, we can see it adhere yet gradually move along; so the sucking-disk not only is an anchor but is also a locomotive organ.

Examining the other portions, we find the anemone in its structure to be a simple sac with a sucking-disk at its lower end; the edge of the upper end divided off into lobes called tentacles which may be long or short, and are hollow, and connect

with an opening in the interior of the bag formed by the outer wall and the wall of the stomach which hangs in the animal; there is no mouth or throat, a simple opening in the centre of the tentacles performing this office.

We see that the anemone is one of the simplest animals to be imagined. The food is caught by the tentacles (which are provided with innumerable stings or lassos, which benumb small animals) and drawn by them down into the simple stomach where digestion by the aid of sea-water is carried on.

Now if we should make a section of one of these anemones, we should find that the body is divided up by six partitions reaching from the outer wall and seeming to support the stomach or mouth-cavity. In the centre of each of these rooms is another partition, which, however, does not extend to the centre, and there are many other small ones. The large partitions are perforated, so that the food taken in at the mouth circulates from one room to another, somewhat as blood circulates in the human body.

So we see that the anemone is a simple sac divided up into partitions; and I am sure that none of my readers will for a moment confuse it with a beetle, or a butterfly, or any insect.

Now try to imagine that this Nahant anemone has the faculty of taking lime from the water that passes through the rooms just described, and of depositing it in and about itself heaping it up gradually, and we shall have grasped the whole coral idea; for this absorption or reception of lime, and its subsequent secretion, constitutes the only great difference between the corals and the anemones. One is a polyp which cannot secrete lime, and the other is a polyp that does. There are other differences, but this study of a polyp is sufficient to show that corals cannot be classed as insects; but as polyps which secrete lime, not building it up, but secreting much as we secrete our bone material.

To more forcibly illustrate this: if we take a piece of dead star-coral, or *astrea*, we shall find it made up of many little cells of lime each with a hollow in the centre for the mouth, and with radi-

ating partitions all around which have been secreted in the little apartments.

The corals or lime-secreting polyps are of many kinds. Some are single and are a foot or more in length, as the *fungia;* others by budding and branching form communities, as the branch-corals; others again assume the form of enormous heads eight or ten feet across, while many more imitate leaves and assume various beautiful shapes, and in the aggregate constitute reefs, shoals, and islands which are important factors in strengthening the globe. So that insignificant as it appears, the simple coral animal wields a mighty power, and has ever been an important agent in building up continents.

While the trees, flowers, and other vegetation beautifies the upper world, the coral groves, sea-fans, plumes, etc., perform the same office in the country under the sea. It is often enjoyable in our Northern waters to drift and observe the great fields of kelp and other algæ below; but this does not compare with the wonders of a tropical sub-marine view. There the water is as clear

as crystal, and very small objects can often be distinctly seen forty and fifty feet below. The finest displays are in shoal-water of from six to fifteen feet in depth. Here for acres we find the bottom covered with a growth of branch-coral two and three feet high, growing in patches, cut up by streets or lanes two or three feet wide, with pure white sandy bottoms, so that one may, as I have frequently done, walk along waist-deep in a veritable coral city. These streets are sometimes what are termed "blind leads;" in other words, they do not open upon the reef, but are surrounded by coral. Besides these shallow lanes, in walking or poling a boat along we may come suddenly to a channel, so deep that the water is a beautiful blue, and bottom cannot be seen. These rivers of blue are merely branches from the main channel and have been formed by a current; but often their sides are so precipitous as to be absolutely up and down, a perpendicular wall of coral a hundred feet high, perhaps. The charming contrast presented by this wall of polyps and the blue water of these channels can hardly be described; the living coral

is a rich olive-green hue, while many of the tips of the branches which have been attacked by fishes or worms, are pure white.

I have frequently dived twenty or thirty feet beneath the surface, and swam along skirting this bristling and wonderful living wall, obtaining some strange glimpses of life under water. Here a great coral worm enveloped a branch. Between other branches gorgeous-hued angel-fishes glanced at me in amazement; while down near the bottom would be seen the whips of the cray-fish moving nervously to and fro.

Such trips were not of long duration; but in a minute in clear water much can be observed, and the under-water excursions were often repeated, and many fine specimens of coral and shells secured which could not be found in any other way. I often noticed in swimming under water that the fishes were not as timid as one might suppose. I have had small ones follow me and approach within reach as I poised far below, and this is often the experience of professional divers.

The branch-corals, which flourish in all seas

where coral is found, constitute but a small proportion of the group. Next in importance came the coral-heads (*astreas*, etc.) These grow on the reefs in the Gulf of Mexico on the edges of the channels, and attain enormous size. Some that I have seen at Garden Key were six feet across, and from three to four feet high. When approaching them they seem to be ornamented with flowers blooming all over their surfaces. These seeming flowers are boring-worms which have penetrated the coral; their breathing organs resembling the petals of brilliant blossoms. At the slightest disturbance they disappear, leaving the orifice of a tunnel visible.

The great coral-heads are sometimes exposed at extreme low tides, the polyps upon the surface then dying; and finally the dead matter washing or wearing away, a huge vase is formed, its sides covered with living polyps, while the interior is a great hollow — the home of fishes, crabs, crayfish and sea-urchins.

The head and branch corals, in fact most of the corals, except the *fungia* or mushroom, are com-

munities, the polyps increasing by budding, and so forming an aggregation of animals. No subject relating to this topic is so interesting as the coral-reef, the practical result of the life of the little animals. The author resided several years upon a key whose foundation was their work. It was half a mile around, embracing thirteen acres of white sand composed of coral, shells, and the remains of marine animals and plants all ground and washed up by the waves; but so low was it that in the very centre, and in front of our house, I have seen the water rise a foot, showing that it permeated throughout the entire under-service.

It is known that the corals which are recognized as reef-builders, the branch and head-corals, do not flourish at great depths; in the Gulf of Mexico at about forty or sixty feet. In localities farther south this limit may be extended; but reefs in very deep water do not exist. They do not commence to grow until the sea-bottom has been elevated to within sixty feet or so of the surface. The bottom of the ocean in its contour differs in no respect from the land; there are the same hills, valleys,

CORAL VASES ON FLORIDA REEF.

HERMIT-CRAB WITH CORAL-GROWTH.

mountains, plains and plateaux. Wherever in the coral-reef belt (which may be considered to lie between 35° north and south) the top of a sub-marine mountain approaches within sixty or one hundred feet, more or less, of the surface, there we find coral-reef in some stage; and according to their form or method of approaching the surface they are given different names, as barrier-reefs, atolls, fringing-reefs, etc.

But it is evident that the bottom must have been elevated to reach this zone where reef-making corals commence their growth, and the methods by which this elevation is accomplished are among the most interesting features of the subject.

If we take a handful of material brought up by the dredge from the Gulf Stream between Loggerhead Key and Havana, we shall discover the secret. Separating the material we find a strange assortment. A large proportion is fine mud which we put aside for microscopic examination; but here is a mass of tubes formed by a worm; there the ground shells of sea-urchins, the hard portions of crabs and shells of various kinds, all

mixed in a conglomerate with the remains of innumerable other animals. So we see that the inhabitants of this submarine world do important work in building the plateau upward toward the surface.

Now let us examine under the microscope the soft mud or sand which largely constitutes the bottom. A revelation! Instead of ground shell we see it is made up of numberless minute shells, many of them entire, and some of beautiful design. They are not mollusks, however, but the shells of some of the lowest of animals and plants, known as *foraminifera* and *diatoms*. In some parts of the ocean these beds of shells are of great depth, and form a thick sediment on the bottom, called the globigerina ooze.

But where do all these shells come from? From the open water above and below. We find every drop alive with wondrous forms, so many that it has been estimated that if they are as numerous at a depth of six hundred feet as they are near the surface, there must be sixteen tons of them in the upper one hundred fathoms of every square mile of the

ocean. How many billions of shells are required to weigh sixteen tons, when each shell is almost invisible, would be difficult to even imagine, but in this unaccountable number of forms we see an the increasing weight crushing those beneath into a powder, ever accumulating and growing upward; so that we can see that in time the top of the submarine hill will surely be elevated until it projects into the zone of reef-making corals.

But before we follow the history of the reef let us contemplate again the rain of shells. In the deep ocean or in the valleys, there is little chance vast numbers, as we see in the globigerina ooze, reach the bottom entire, piling one upon another, important factor in the preparation of a platform for reef-building. Enormous quantities of these minute organisms are constantly dying, their shells sinking; so that in the ocean — if we can but imagine it as it would appear through a huge magnifying-glass — there is a constant shower of shells falling upon the bottom. Many are dissolved, but of their ever, without help, building up to the surface. This help comes in elevations of the

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crust. If we go to the Straits of Dover we shall find in the Dover Cliffs the practical results of untold centuries of these shell-rains assisted by crust elevation. The Dover Cliffs are made of chalk, which is really lime, deposited upon the bottom of the ocean in just the way we have described. After ages of shell-deposits, an elevation of the crust occurred — that is, the bottom of the ocean was thrust by some convulsion high into the air, giving us the white Dover Cliffs of to-day.

The stones of which the great pyramids of Egypt are made are formed of a species of foraminifera; the blocks are literally sections of an old ocean bed. How many shells there are in these great monuments it is impossible to conceive. The pyramid of Gizeh measures seven hundred and sixty-four square feet at the base, has a perpendicular height of four hundred and eighty feet, covering about four acres; and seventy-nine million twenty-eight thousand cubic feet of these fossil shells were consumed in its formation. An English architect has recently had the patience to figure the cost of erecting such a monument to-day, and his esti-

mate was one hundred and forty-five million dollars!

Along with the shells of foraminifera in the submarine depths we find vast numbers of forms equally beautiful, known as diatoms. These are assumed to be minute plants, and they also are important factors in building up ocean-bottoms. They not only rain upon the bottom of oceans, but the fossil forms are caught up at times from the elevated beds along-shore and whirled through the air in vast showers. When the late Professor Darwin was at St. Domingo he noticed one morning that the air was filled with a thick dust. Some of it was collected from the rigging of the vessel and sent to Professor Ehrenberg, who found that in it were represented the silicious shields of sixty-seven different organic forms; two being marine, the rest fresh-water organisms which were being borne out over the ocean to unite and join the submarine rain of shells. Some idea of the enormous numbers of these plant-forms can be gained when it is known that the dust-clouds or showers are sometimes so thick that on account of them vessels

have run ashore just as they would in a fog. The dust-rain descends upon vessels a thousand miles out at sea; South American forms are carried to Africa by currents, and African species transported to South America.

One of these showers fell in Lyons, France, in 1846, and it was estimated by Professor Ehrenberg that over seven hundred thousand pounds of material fell, of which ninety thousand were the shells of microscopic organisms. One shower observed by Darwin at sea had an estimated breadth of sixteen hundred miles and an area of over a million square miles. Sir John Ross describes a bank, called Victoria Barrier, four hundred miles long and one hundred and twenty miles wide, composed almost entirely of these shells. The city of Richmond in our country is built on a stratum of them nearly twenty feet in thickness.

Having shown some of the remarkable agencies that are helping to build up platforms under the sea, let us return to the history of the coral-reef. Years go on and this accumulation reaches within sixty or seventy feet of the surface; then a new

factor is noticed. Corals begin to grow, and soon the top of the ocean-mountain has a crown of beautiful forms — corals, fans, plumes. These grow rapidly, die down, adding to the mass until the surface is reached. The waves grind up the branches, wash them up in lines or circles, according to the shape of the platform, until finally the dead coral rock is dry even at high tide, and the coral key or island formed. Seeds, always drifting about on the ocean, are washed upon the bank, and soon palms or mangroves take root and grow. The birds discover it and make their nests there, and as the key becomes larger and more habitable man takes possession — probably without a thought of the little creatures whose lives have gone to build his home.

The forms that coral islands take depend upon circumstances, as the shape of the platform, the prevailing currents and direction of the wind, the food-supply of the corals; and in some cases the elevation or subsidence of the crust affects them, though by no means so much as is generally supposed and chronicled in many of the late books.

The rate at which coral grows has also been as much mistaken as the method of reef-formation. The general idea is that it is extremely slow. I have observed branch coral which grew four or five inches in a year, and in certain localities on the Florida reef it is even more rapid. A brick bearing a small head of *meandrina* was kept under observation a year, and the coral found to have grown an inch during that time. This was in an aquarium; the growth in open water with a more abundant food-supply would be more rapid. In the Keeling Atoll a channel was dug through to admit the passage of a small schooner. It was not used for ten years, and was then almost completely filled with growing coral. On the Madagascar reef masses of branch-coral were fastened by stakes three feet below the surface, and seven months after were found almost at the surface — an astonishing growth.

Corals often assume curious shapes. A specimen of Eastern coral was formed almost exactly like a base-ball bat, and six or seven feet in length. Leaf-coral often assumes the appearance of plants,

and one branch that I saw resembled a huge pair of antlers. Some heads grow in a perfect oval, while others are flat. Often they seem to imitate groups of plants, and a piece that I brought up from about thirty feet in the Gulf of Mexico resembled a bouquet of flowers.

While individual heads and branches take strange forms, the configuration of reefs and keys is equally interesting. Long Key of the Tortugas group, for many years was nearly a mile long, and not over one hundred and fifty feet wide. This form was produced by the prevailing northwest winds throwing up the white sands of an extended lagoon The key was pure white, and composed almost entirely of ground bleached coral, broken shells, and the leaves of a lime-secreting seaweed. At every storm the key changed, and some years after my observations a friend who visited the spot told me that it had almost disappeared, and now I understand it is forming again. The lagoon to the eastward of this reef is protected by a wall of dead coral, bare at low tide, and after a storm I have seen it thrown up like a New England stone

fence, so that at low tide I could walk along upon it for a mile. But very hard walking it was; the rocks being dead heads of *meandrina* and *astræa* cut and worn in every direction, and each the home of myriads of animals, crabs and *echini* being the common forms, while almost every one gave shelter to one or more of the beautiful spotted shells, *cyprias*, so common as mantel ornaments.

This reef almost approaches the atoll form, which is found in all its perfection in the South Pacific where almost circular ridges of coral are seen with a central lagoon often affording a fine harbor, while the outlying ridge is covered with a luxuriant growth of trees, generally palms or mangroves. The atoll is formed by dead coral rock thrown up by the winds, the action of the waves grinding up great quantities into sediment, which washes into the interior, there sinking and forming a flat or lagoon upon which seaweeds and corals grow, while currents form deep channels, until we have a central lake surrounded by a fringing island often only a few feet in width. In some cases the lagoon finally becomes filled up or partly so; in

others the dead calcareous matter, as the branches of coral, etc., are carried away in solution by the carbonic acid of sea-water, and thus the lagoon for years retains about the same depth. But each atoll is acted upon by different winds, currents, etc., and has a history more or less its own.

While the reef-making corals are confined to certain limits near the surface, this is by no means true of all corals; for instance the *fungia*, or mushroom coral, a single polyp, is found at great depths. Ten genera have been found living at a depth of one mile from the surface, four at nearly two miles, while the *Fungia symmetrica* has been discovered in localities ranging from one hundred and eighty feet to three and a half miles. In these greater depths the pressure is enormous, and the temperature presumably but little above freezing. So it will be seen that the popular belief that all corals require warm water is subject to some exceptions.

Corals also have a wide geographical range. One, called *Deltocyathus Agassizii*, is dredged in the Florida channel in water nearly two thousand

feet deep, and also off Boston at the mouth of the Massachusetts Bay at a depth of about a thousand feet, where the temperature is about 39° Fahr. Other corals are found on the Maine coast, and still another has been traced from the Florida straits to the banks of Newfoundland, and even to the cold waters of the Norway coast.

Coral is often found in curious places. A crab was once caught which had a small bunch covering its shell. When the Atlantic cable, or a portion of it, was taken up for repairs a coral was found growing upon it, and I have visited an old wreck where the interior was fast filling up with a rich growth of beautiful polyps.

The most valuable coral is the red variety, an Alcyonarian, found in the Mediterranean Sea, where the business of collecting it is of great importance, over eighty thousand pounds being taken every year. Algeria sends out about three hundred vessels, and over thirty thousand men are employed in the fisheries, the entire catch of coral being valued at considerably over a million dollars.

The coral is collected principally by nets formed of cross-pieces of wood to which are fastened tangles of rope. This contrivance is weighted and dragged along over the bottom; the branches becoming entangled and so brought to the surface. In some localities the men dive for the coral, but, as a rule, nets or drags are used.

When first collected the coral does not present an attractive appearance, and it is only when the outer portion which contains the cells is removed that the red and beautiful axis is seen. The red coral is quite different from the reef-builders. In the latter the animals rest in cells in the very body of the branch, as it were, but in the red coral they are in what might be termed the bark, so that when a branch is scraped little or no evidence of a cell is seen.

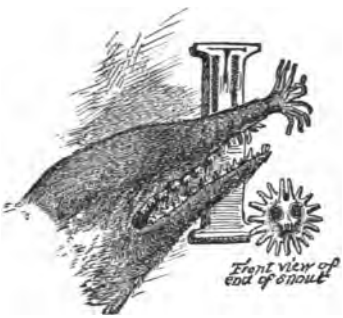
The red coral is divided up into many different grades according to color and to hue; the delicate tints of rose pink being the most valued and bringing large prices. The small pieces, and odds and ends are made into bracelets, necklaces, etc., and are much worn in Italy, it being supposed by some

of the superstitious peasants that coral has the power of warding off danger.

In a number of sections in New York State, as the Helderberg Mountains, large coral reefs can readily be traced, and the specimens though hardened in the solid rock still show their form and structure. These entombed skeletons tell a wondrous story of the changes that have taken place, and show that in years gone by coral-reefs grew and formed in the far North. In those days the State of New York was under water; a difference in zones existed, and Boston, New York and the adjacent country had a temperature presumably like that of Southern Florida to-day, and a very similar state of things existed. In the Catskill Mountains I have walked over ledges where almost the entire surface was made up of sections of crinoids somewhat similar to those now found in East Indian waters. Here also were sponges entombed in the solid rock, trilobites or crabs; and in one glen, a veritable moss-covered arbor; not a stone or rock but concealed forms telling of the old ocean that rolled over the spot many ages past.

CHAPTER V.

HOMES UNDERGROUND.

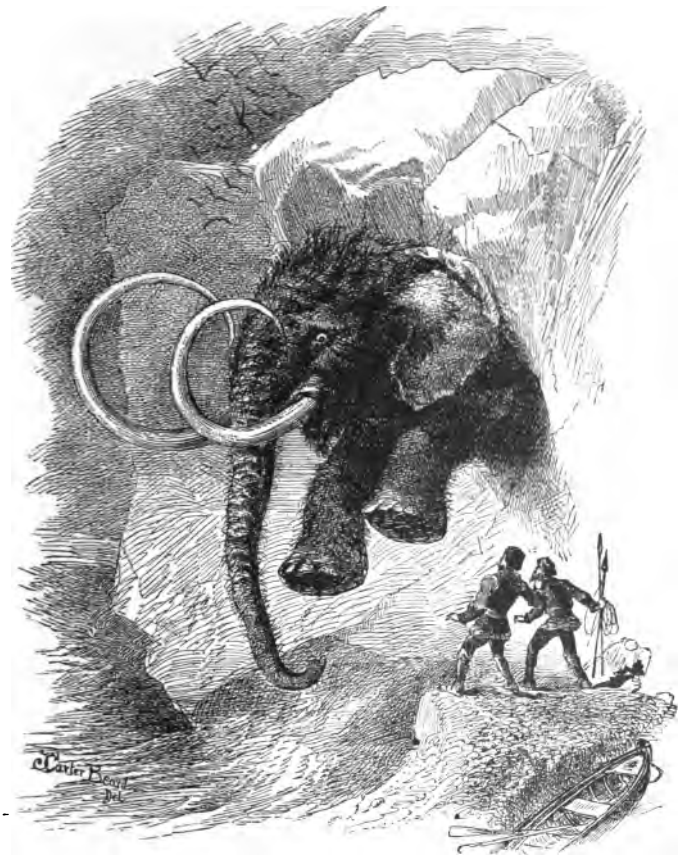


HEAD OF STAR-NOSED MOLE.

IN the last century a Swedish prisoner-of-war named Müller, who had been confined in Siberia, returned from the cold and desolate country, bringing with him many curious tales from the North, which caused no little wonder and excitement in the quiet city of Amsterdam. For a long time he entertained his old neighbors and friends gathered about the evening fire, rehearsing his experiences and relating stories. Among the latter was one which seemed to fascinate his listeners more than all the rest.

This favorite story was simply about a rat; but a rat enormous, and very terrible to look at. Müller did not profess to have seen the animal himself; but he had talked with many natives who had, never seen above ground, but that they had often gigantic underground rat, was the most marvellous of all creatures.

Müller's informants told him that the animal was and one and all averred that this *Tien-shu*, the crept into crevices of the earth formed by it as it ploughed along in the Ural Mountains, digging out the soil with two huge horns which were fastened to the head just above the eyes. These horns the natives valued very highly, and sold them as ivory; but they could only be taken when the animal was dead. Many horns were obtained, however, as the rats often perished by trying to burrow in soft sand, when the treacherous material would pour in and smother them. Some had seen the animal alive in grottoes on the other side of Beresovsk, and all concurred in the belief that it died as soon as it saw the light. They stated, moreover, that its flesh was remarkably cooling and wholesome.



"THE GIGANTIC UNDERGROUND RAT, TIEN-SHU."

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Nor does Müller's story lack confirmation if we may believe the account of certain Chinese *literati*, who not only described the *Tien-shu*, but explained the shocks of the earthquake by saying that they were caused by the movements of the great rat underground. My readers will have suspected what the origin of this curious belief was, and will agree that it is no wonder the simple people of the North believed the huge mammoth to be an underground animal. Did they not always find it beneath the surface? Had not their fathers and grandfathers seen it washed out of tundras and torn from cliffs and ice-heaps during the spring floods? and had they not fed their dogs on the flesh, and even eaten it themselves? What was there impossible in the story? all the facts pointed to its truth. For many years the ivory of the mammoth, the great hairy elephant of the North, was collected and sold; the natives supposing that they were taking the tusks of an animal which bored about in the earth just as does the mole to-day. Nearly all the mammoths which have been found, appeared at first in the side of immense cliffs frozen in a solid

mass with gravel, earth, and ice, and where they had been imprisoned and preserved for ages.

A large number of animals make their home underground. As a rule they are provided by nature with means which perfectly fit and adapt them to such an existence. The fore-feet are strong and powerful; the claws greatly developed, so that the earth can be thrown out quickly; and we find that some have veritable sacks or bags in which the material is carried out.

One of the most familiar of our underground livers is the common mole, whose work can be seen all over our Northern orchards in the morning; showing that their tunnels, like those of the fabled *Tien-shu*, have been made with remarkable celerity. But however well the mole is known by its ridges, there are comparatively few people who ever see them alive, for the simple reason that the little creatures are extremely timid and shun the light, coming out only at night. The only one that I have ever seen moving about during the day was one which a cat had caught in the deep grass of an orchard.

The mole is a thorough subterranean worker. Its entire make-up tells of a life underground. It is, comparatively speaking, blind, its eyes being mere specks; the smallest black bead will represent them. It is often stated that the mole has no eyes, but this is an error; and as insignificant as are these little organs they are present, the lens consisting of a small number of minute cells. The retina is not so elaborate as seen in other animals; and probably some moles *are* blind from the fact that the optic nerves, which carry the picture to the brain, have become degenerated by disuse.

But if it has poor eyesight, the mole possesses a remarkable nose and a powerful scent, which fully make up for any optical deficiency. This scent enables it to capture all the worms and insects which lie in the path of its burrows; and that these little creatures are a valuable ally of the farmer is evident from the fact that it is estimated that a single one devours twenty thousand insects a year. Actual experiment has shown that one will devour four hundred and thirty maggots, and two hundred and fifty grubs in four days. One

under observation ate eight hundred and seventy-two maggots and three hundred and forty grubs in twelve days; and in another instance two of these voracious little animals ate in nine days three hundred and forty grubs, one hundred and ninety-three earth worms, twenty-five caterpillars, and a mouse, skin, bones, and all.

The most remarkable mole in this country, as far as appearances go, is the star-nosed mole; so called from the fact that from its nose radiate a number of fleshy points, which are of use in aiding the little animal to obtain its prey.

All the moles are noted for their burrows; but in the elaboration of its home and the architectural skill exhibited, the English mole, *Talpa europea*, is without a peer amongst all underground animals; and when we consider that this habitation is built in the dark, and by a creature presumably low in the scale of intelligence, it is most wonderful.

Although the ridges of the English mole are seen extending in every direction, the little creature really confines its maraudings, if so its excur-

sions here and there can be termed, to a comparatively limited space. The fortress or nest is at one end, and is a most complicated affair, generally built near the roots of a tree or under a prominent hillock which is firm and well packed, and when finished is a room surrounded by two galleries supported by five pillars which are separated by as many passages leading above and below. In the centre of the lower gallery and beneath the upper, the nest is formed, and the young reared. The upper gallery can be reached from this by three passages, and there is another which extends downward at first for some inches, and then rises again, joining a high road which, next to the nest, is the most important feature of this subterranean home. It extends in nearly a straight line from the fortress, and is the highway from which all the roads lead. It is just wide enough for a single mole to pass, and when two meet, and both are determined, a contest ensues; but usually one will retire into some of the numerous passages which branch off from it. These radiations are the hunting-grounds

of the little animal, and wind about, crossing and passing each other in a wonderful manner, and are continually being added to by the hungry hunters. From the high road at least nine branches lead to the upper or lower gallery of the nest, and in making these tunnels the little worker is careful not to have the doors or openings of the upper gallery over those of the lower; in fact, everything is arranged to render escape easy in time of danger; the runs, alleys, and by-ways, all are constructed with that end in view.

While the mole is apparently a clumsy creature on the surface, its movements are extremely rapid underground. Some curious experiments have been made to test its speed. Thus a French naturalist, having ascertained that a mole was at the end of the high road farthest from the nest, inserted a horn into the tunnel near the end, the mouth-piece being out of the ground, and then placed several little flags which penetrated the tunnel, along the route, hoping that when the mole darted away it would knock them over in succession, and so its speed be determined. The ex-

periment proved a perfect success. When the little animal was supposed to have reached a locality near the end of the road the naturalist blew a loud blast upon the horn, which undoubtedly reverberated through all the tunnels and passages, sadly frightening the mole, which started at a tremendous speed down the road toward its castle, the spectators observing the flags go down in such rapid succession that they expressed the opinion that it was travelling as fast as a horse could trot.

In Southeastern Russia, and Western Asia is found an extremely comical burrower, an ally of the mole, known as the elephant shrew, *Myogale moschata.* This little animal is aquatic, and forms long burrows in the earth where its nest is made, and though not showing the remarkable architectural ability exhibited by the European mole, it is a very interesting borer. In appearance it somewhat resembles the common shrew, but its nose is developed into a complete proboscis, which is used to a certain extent like that of the elephant. It can be moved in any direction, can grasp a bug or worm and carry it to its mouth ; in short, acting

so much like that of an elephant that the name is well applied.

When the first white travellers penetrated Australia they heard many curious stories concerning an animal the natives called the mullingong or tambreet. So remarkable were the descriptions that the creature was considered fabulous. One Australian endeavored to describe it by showing a duck's bill, a cock's spur, and the fur of a cat, to which combination he added the webbed foot of a duck, all of which, he said, the mullingong possessed. Moreover, it was a swimmer, a water-loving animal, and formed extensive burrows deep in the ground for the preservation of its young. An animal having the characteristics of bird and beast would certainly be a novelty; but finally the mullingong was discovered and found to be no less a wonder than the description of the natives implied.

This strange creature is now known as the duck-bill or Ornithorhynchus, and really combines the features of several different animals. It is an aquatic milk-giving animal, about eighteen inches

long, covered with a rich chestnut-brown fur. Its mouth projects into a horny bill as perfect as that of a duck, and is furnished with several hard rounded teeth. Just back of this are the shining bead-like eyes. The toes on the front-feet are webbed, as in a duck, and the hind-feet of the males are armed with a perforated spur. In fact, a stranger combination could hardly have been conjured up by the most vivid imagination, and as if this were not enough, it is now known that this milk-giving, bird-billed little creature lays eggs like a reptile, from which the young are hatched.

These quaint creatures are quite harmless, and are easily tamed, making exceedingly interesting pets. An English naturalist, who spent a number of years in Australia in order to study their habits, kept many of them about his place. They would climb upon the furniture in the room and upon his shoulder, and go to sleep on his lap coiled up in a perfect furry ball. In their native state they live upon insects and small animals, which are found on the bottom of streams, to obtain which the lit-

tle creatures swim along, overturning the stones with their curious bills.

The home or nest of the duck-bill is far underground, and is, as a rule, begun under water at the bank, so that it is extremely difficult to find them. The natives' method is to walk along the side of a river or stream, and pierce the ground with a long sharp stick. The burrow is gradually worked upward until it is perhaps four or five feet from the surface of the water, or at least above the possibility of a flood when the river is high, and then runs down for a number of feet, finally leading into a large room. Here grass, leaves, and other material are taken by the duck-bills and the nest made, upon which the eggs (as a rule, two) are deposited. Very little is known concerning their habits or those of the young; but that the parents are very skilful in hiding their home from intruders is evident. The discovery that these animals lay eggs is one of the most remarkable and interesting of modern times.

During a recent trip across the plains, and in crossing a piece of country where the remains of

old lava beds were succeeded by stretches of level land, I came suddenly upon a coyote, the cowardly wolfish barker of the West. When I first espied him he was standing in a curious position with legs well apart, as if bracing, and his head turned aside. For a moment I thought he had been injured, but a second glance showed that this was far from being the case. He was standing in the midst of a prairie dog settlement, and in a circle about him were numbers of the dogs in the various positions they assume; some standing upright, others pawing the air, and uttering curious cries; but one and all were on the alert, and not to be deceived or cajoled by this pretender. It was evident that the coyote was endeavoring to convince the prairie dogs that he was friendly, only a harmless member of the animal kingdom making them a visit out of pure friendship; and his way of showing this was to assume a ridiculous attitude and advance toward them step by step. But the dogs were altogether too knowing for this, and as the coyote drew near they dropped into their holes, others appearing as

he moved on, so that he was ever in the centre of an interested crowd; but he found that to approach near enough to seize one of the little marmots was an impossibility, and as I left my place of concealment, he raised a dismal howl of despair, and trotted off.

The prairie dogs though cunning enough to avoid the coyote are often in their young days victims to a still more terrible enemy, the rattlesnake. The dogs, or marmots, more properly, build their homes underground, forming them in the level prairie or flat land; the opening being surrounded by a pile of earth, which constitutes a piazza or platform, upon which the animals sit. At the bottom of the burrow the nest is made, and the young reared. As there are no nooks and corners for the snakes to hide in, they sometimes enter the homes of the marmot and live there; not in peace and harmony, as some would have us believe, for the young marmots often disappear in a remarkable way, and I believe the snake could possibly explain it.

Two such entirely different animals would seem quite sufficient for so small a home; but there is

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still another inmate — a small burrowing owl; so called because it will itself burrow where there are no prairie dogs to dig a hole for it; but when it can find a burrow, it takes up its quarters unbidden; so that these three utterly unsocial creatures are sometimes, though not as a rule, found in one home, just as any animals might take refuge in a common nest; but that there is any agreement between them to live harmoniously, as is often related, is a gross error. The snake probably has the best of it; the young owls and prairie dogs being tidbits quite to its taste; and so we see that all the homes underground are not as safe and secluded as might be supposed.

The settlements of the prairie dogs are found in the Western country, covering vast areas. I have seen settlements that extended as far as the eye could reach, each nest being marked by the bushels of material which had been brought out from time to time, in many cases, probably, to form a suitable lookout from which to observe an approaching enemy.

Some years ago a curious underground home

was discovered in the islands known as "The Chickens," off the east coast of New Zealand, which gave shelter also to three entirely different animals, which seemingly lived together in friendship; perhaps for the reason that they were all harmless and not particularly aggressive. The owner of the home was a little bird, a petrel; better known to us as the Mother Carey's chicken. In these bleak islands the birds had made their nests, burrowing into the soil in such vast numbers that in certain places the ground seemed entirely honeycombed by them. At the end of the long tunnel, a room was widened out, and a soft bed made of moss or grasses, upon which the eggs of the petrel were laid. On the other side of the room was another occupant — a disagreeable-looking lizard, known to science as the *Sphenodon punctatus*. The latter never ventures out during the day, and lives to a great extent upon the food brought in by the petrels. According to some authorities the lizards sometimes make the burrow and the birds become the intruders. The third member of the trio is a rabbit — a strange family!

It is a common saying in Southern California that the rats live in trees and the squirrels in the ground. This is true to some extent, as a wood-rat builds a large nest in the trees, and certain squirrels burrow.

In a small field in the San Gabriel Valley I have counted the heaps of twenty or thirty of these squirrels; the little animals darting about here and there, or standing upright, and so resembling the soil in color that it was often difficult to distinguish them. The holes of these squirrels are very large, and are sometimes inhabited by a small burrowing owl. These owls are very comical fellows and very social. In riding through the valley where their holes were a characteristic feature, I was obliged to be constantly on the lookout to prevent my horse from falling into them; and occasionally when a bird would appear, and I would gallop in chase, it would fly a few yards, and when routed again hover overhead not twenty feet away, and snap its beaks and shriek with rage, showing all the petulance of a spoiled child annoyed at being disturbed.

In riding through a cañon in the Puente Hills, foot hills of the Sierra Madres, the sides were seen to be burrowed every few yards with the nests or homes of two species of owls, which presented a comical appearance, especially one, called the "monkey face," as they sat on the heap of dirt in front of their doors and blinked wisely at us.

The work which birds accomplish in forming their homes underground is often remarkable. The burrows of the cliff-swallows are familiar examples, showing a vast amount of labor performed by a delicate bird.

But in the Southern Ocean near Tristan da Cunha Islands are the most wonderful underground homes found. In some of these islands there are such vast numbers of penguins that they literally cover acres and acres, often the entire island being cut up into their lanes and streets. Their nests are upon the surface, but underneath the rich loam is tunneled in every direction by a perfect maze of nests, the subterranean homes of several species of water-birds. So thick indeed are these nests that a naturalist in walking was actually in fear of

his life. At every move he broke through, from six to eight inches, into a fresh tunnel, and stepped either upon the birds, or eggs. On the surface numbers of penguins were pecking at him; striking at his face and eyes with their sharp bills as he fell.

In Southern California the small lizards dig holes and take refuge in them, and often share them with scorpions.

The most interesting underground home in this country, however, is that of the great tarantula or trap-door spider. Some of these, which I have seen farther South, if placed in a saucer could rest their legs on the edge all around, and are the veritable giants of their race. An ally in South America captures small birds, but the one first mentioned is a subterranean dweller, living on small animals and insects. The nest is built in adobe ground, which is a hard clay-like soil. When a place is selected, the spider proceeds to excavate it in a circle with its mandibles, taking it out piece by piece, until finally a well from six to eight inches deep is seen. It is now rounded off so as to pre-

sent a regular surface, but is even then too rough for the tender body of the spider to rest against, and may be compared to a house all finished but the door and plastering. The latter is quickly accomplished; the spider attaching a thread of silk to the top, spins on, passing round and round until a perfect sheet of shining silk covers the whole interior, hanging on the wall like a delicate lace or silk tapestry, and forming a veritable ladder for the spider, whose sharp claws catch upon it with the greatest ease.

The lining finished, the patient worker turns its attention to the door, which is the most remarkable feature of this curious home, being fastened to the side by a hinge, and so perfectly adjusted that it closes itself after the spider has passed out. The door is made by attaching silk upon one side, after which the tarantula moves as before round and round, gradually forming a silken door, ranging in size from a silver dollar to a fifty-cent piece, depending upon the size of the opening. As it approaches completion this door is, of course, extremely light, and so the spinner weights it down

with adobe until finally, when finished, it is flat on top, the exact color of the surrounding soil, and fits the opening so perfectly that the sharpest eyes fail to see it, and, moreover, it is absolutely water-tight. The little owner has no difficulty in opening it; and in returning to the nest deftly lifts up the cover, and slips in so quickly that many a pursuer is mystified. If an enemy does discover the secret the spider will often turn and seize the lower part of the door, which is a soft cushion, and by bracing back, with feet against the side of the tunnel, hold it so strongly that considerable exertion is required to lift it; when all efforts fail the spider will sometimes allow itself to be pulled out, and then makes a leap at the enemy. A gentleman in Los Angeles informed me that one of these spiders sprang a distance of several inches at him.

In the North the badger, wood-chuck, and others are well known as delvers in the soil; and in South America some of the most curious of all animals, the armadillos, are even better equipped for such a life. The peba, *Tatusia novemcincta*, is enveloped in a complete armor, the carapace being divided

into rings so that the animal can coil itself into a perfect ball, and thus defy the largest puma. Its feet are of astonishing size, and armed with powerful claws which enable it to make long and extensive burrows. The three-banded armadillo is a famous burrower, and when coiled up in its underground home might be compared to a cannon-ball in the muzzle of a gun.

Many of these animals are much esteemed by the natives, and as it is impossible to overtake them by digging they are routed by a systematic smoking, which soon brings them to the surface. After eating the flesh, the natives often put the shell to a peculiar use, making it into a guitar or rude musical instrument, while the tail of a fossil species is used as a trumpet.

Even more remarkable in appearance than the armadillo, is the *pichiciago Chlamyphorous*, of South America; a little creature with armor on its back, so artificial in appearance that it might be supposed to have been put on to give the animal a comical aspect. Its claws are enormous when compared to the size of the body, and by their

use the little *Pichiciago* can disappear beneath the surface with wonderful celerity. Its position in digging is a comical one. When the hole or burrow is first opened the fore-claws are employed, and when sufficient earth has been thrown back it raises itself up, supporting itself upon the fore-claws and tail, leaving the hind-claws free, which now work like the arms of a wind-mill, in tossing back the earth, and thus alternating, first on all fours, then on the tail and fore-feet, the burrow is formed, often leading far into the earth, and crossing and re-crossing until a maze of lanes and walks is the result. In these subterranean abodes the little ones are reared; but concerning their habits very little is known.

In South Africa a very curious subterranean home-maker is found. The natives call it the ground-hog, from its resemblance to one of these animals, but it is better known as the aard-vark. Like all the diggers it has powerful claws, and has, perhaps, more of a motive to dig than many others, as its food consists almost wholly of ants, which it digs out of the ground. Some idea of the

rapidity of its movements underground can be obtained from the fact that one which was observed by a hunter walking along, succeeded in digging a burrow and disappearing before he could reach it. Their homes generally lead downward at a sharp angle, and are then enlarged into a commodious chamber in which the family of the aard-vark resides.

The ants which constitute the food of these curious creatures, are themselves perhaps the most ingenious and interesting of all underground miners, and the skill and ability displayed in some of their works show something more than instinct. The homes of the Termites, or white ants as they are incorrectly called, having little affinity with true ants, are perhaps the most remarkable. The nests are enormous mounds, often ten or twelve feet high, and twenty-five or thirty feet in circumference, and so solid that man and large animals can mount them with perfect security. But woe befall the animal which should chance to fall into one! as in a moment it would be attacked by myriads intent upon vengeance.

To give some idea of their numbers, in St. Helena, where they were accidentally introduced, the greatest damage was the result. Jamestown was literally devastated by them; the cathedral was destroyed, few books of the public library escaped, and everything in the town was more or less injured. The government stores, though packed in tight tin cans, were entered, and thousands of pounds destroyed. How they gained entrance into these cans was long a mystery; but finally it was found that the moisture on their feet as they walked, had corroded the tin so that it had rusted through, leaving small openings. These insects work out of sight; hollowing out the legs of tables and timbers of all kinds; and large supports, which had been supposed to be solid, have been found to be simple shells.

Their homes are a maze of tunnels, among which various apartments are prepared for the young; and in the centre of all is always found a small room which contains the queen-ant, who is watched and attended by the ants of different grades with the greatest solicitude. Some years ago several

American gentlemen were lunching in the City of Mexico when a dessert was served which looked like currants, but was found to be ants swollen with honey. Later they learned that these remarkable little creatures were veritable bottles, which had been hung by ants upon the walls of a subterranean home as a winter supply of food, to be taken down and used, or rather, the honey which they held, as occasion required.

In the far northern country of Nova Zembla the mountain fox, *Vulpes lagopus*, perhaps to escape the rigors of the Arctic winter, constructs its home underground, a maze impossible to follow. The naturalists of the *Vega* expedition, found the lanes and alleys leading to the rooms often crowded and packed with birds which had been caught by the little hunters and stored away for use.

Our common jumping-mouse, *Zapus*, is an interesting burrower, and when caught upon the surface it has been known to leap quite over a man's head. It has been found in the winter at the end of its burrow, coiled up in a ball of grass, apparently dead; but in reality in the strange condition of

insensibility known as hibernation; a state into which many animals pass at the approach of winter to enable them to bridge over the cold season.

These are but a few instances taken from many, illustrating the boundless resources of nature, and showing that not only are the air and water the seeming homes of many forms, but the solid earth is bored and tunneled to give them sustenance and protection.

CHAPTER VI.

HOW ANIMALS PROTECT THEMSELVES.

A NOVEL FERRY-BOAT.

EVEN upon a glance at the so-called lower orders of animal life it is evident that the various forms must prey upon one another to live, and while certain animals are furnished with teeth, claws, and powerful muscles and every faculty for the capture of others, even the most helpless creature seems to be provided with some means of protection or defence; and that these are often of the most wonderful nature every observer knows.

As a rule, the lower the animals in the scale of

life the more elaborate is the defence; even the extremely simple forms, as the jelly-fish and the physalia, being provided with a protection that is remarkably effective.

The physalia, or Portuguese man-of-war, is one of the most beautiful of marine objects — a veritable fairy-ship floating about upon the ocean; a bubble of satin, bearing upon its upper surface a silvery pink-tipped sail which can be raised and lowered at will. No more tempting dainty could be placed before a hungry gull or sea-bird; but never have I heard of such an indulgence. The birds and undoubtedly many marine animals are well aware that the man-of-war, which sails so gayly in the breeze, has a defence of so virulent a nature that it can be touched only with great risk. I have seen a physalia attacked but once, and this was by a young turtle, one unversed in the study of zoölogy, or it would never have made the attempt to dine on so dangerous a creature. I discovered it floating on the surface, and though powerful enough to carry its coveted dinner far under water it had been thoroughly overcome.

Looking under water the beautiful Portuguese man-of-war will be seen to have a dense, purple-hued train of tentacles, often seventy-five feet in length, while the float itself is not as large as the closed hand. Under the glass this richly-hued mass is seen to be covered with little pores, or cells; and if we look very closely, each cell will be found charged with a minute javelin twisted and coiled; in fact, a minute bomb ready to be hurled. Every portion of the tentacles are armed with these javelins, and the moment a foreign object comes in contact with them they are discharged; in other words, each cell turns inside out, and the little lasso-like weapon is propelled at the enemy, the combined effect of myriads often producing a serious shock. Every bather on the New England coast has felt a similar discharge when coming in contact with the so-called sea-nettle — a species of Medusa commonly known as sun-fish, jelly-fish and by other names.

All these jelly-like forms are protected in this way, and undoubtedly the various marine animals find out the virulence of their stings and give

them a wide berth, as so few are known to prey upon them. In the summer, in the Gulf of Maine, the lump-fish has been observed taking a bite out of the centre of the disk, and this is also true of the dog-fish.

But the jelly-fishes have one enemy upon which the stings have no effect. This is the whalebone-whale which has a curious arrangement that enables it to capture vast numbers of the jelly-fishes.

In a previous chapter I referred to a shelless mollusk, called the *Onchidium*, which consitutes the principal food of a shore-loving fish. It has been suggested that they are enabled to eject into the air a volley of minute darts that would considerably astonish an enemy of small size. Whether this is definitely true of the Onchidium it is of certain planarian worms. The instant an enemy touches them innumerable short barbless javelins are hurled into the air, and that they are capable of entering the flesh, and causing an animal to withdraw, is well known. These darts differ from those of the physalia and jelly-fish in the fact that they are not barbed, and are not retractile; in

other words, are discharged like so many arrows into the air, freed from the animal. Such a remarkable defence in so lowly a creature cannot fail to arouse our interest.

In the insects we find many strange methods of defence. The bees and wasps have the sting and poison-gland attached, which is thoroughly appreciated by most birds and by animals in general. The dread of these creatures is instinctive, and they are avoided without previous experience. I noticed this once in a young hound I owned. It was born in the winter, and I received it in the spring before the bees and wasps were out, so that it had never seen either. In the house it amused itself by catching flies, large ones being especially esteemed; but one day when I captured a bee and presented it, the puppy approached it with the greatest circumspection, appreciating immediately that it had a sting, and, in fact, could not be induced to touch it. This caution was instinctive, or one of the results of inherited experience.

A very common method of defence among insects is to feign death. I have often observed

this in beetles which I had dug out of an old root or stump. As soon as touched they would coil up their legs, or draw them up as dead insects do, and no amount of handling could make them give any evidence of life. This has been observed throughout the entire animal kingdom, and is commonly known as "playing 'possum," as it is a device often affected by opossums to deceive their enemies, human or otherwise. I have even heard of an instance among elephants. A herd of wild elephants had been captured, and the men were at work tying them when a large tusker fell over, to all intents and purposes, dead. The natives made every effort to resuscitate it, and finally having convinced themselves that it was dead left it; but the moment they were at a safe distance, the rogue regained its feet, and fled to the jungle, trumpeting with delight at the success of its ruse. The opossum will withstand the gravest treatment before acknowledging itself alive; and in it the perfection of this curious phase of protection is seen.

Many insects rely upon their appearance alone

to terrify enemies. Thus some of the stag-beetles present a terrible array of spines upon their backs. These spines cannot be used in any way by the beetles which are harmless little creatures; but the ponderous bodies and sharp spines are sufficient to intimidate the boldest insectivorous bird.

The sword of the sword-fish, the serrated weapon of the saw-fish, the sharp bill of the gar, and the whip-like tail of the rays with the serrated bony stings, are all protective weapons that few animals care to encounter more than once. These creatures rarely flee from their enemies, relying upon their various armaments, and are, comparatively speaking, slow swimmers.

On the other hand, we find many animals, which have no special means of defence, supplied with remarkable means of escape. The herrings, mullet, and flying-fish are examples of particularly defenceless forms, which are endowed with great powers of speed.

Among the higher animals the kangaroos present a remarkable instance; one small individual was so wonderful a leaper as to have bounded

over a horse and rider in its efforts to escape. This power of leaping and bounding away is the only means of protection possessed by this special group of kangaroos. Though at close quarters the kangaroo is a formidable adversary, with its long sharp claws, when followed they invariably attempt to escape by using their powerful hind legs to force them through the air and over the bushes at incredible speed.

In this country we have jumping-rats of several kinds, which leap ten feet or more; requiring a very sharp pair of eyes to follow them. Under this head, referring to the method of escape, come the grasshoppers and all leaping insects. Their limbs are enlarged to form powerful jumping organs, with which they hurl themselves into the air regardless of direction, thus escaping even the quick-motioned birds in pursuit.

A method of protection directly the reverse of this, is seen in certain moths and a large variety of animals, which when pursued settle upon the ground and find safety in their resemblance to the stones or moss.

The great ant-eater is a slow-motioned creature, and finds retreat from a nimble enemy impossible; yet when standing with its huge tail over its body, it resembles a bush, and thus eludes its follower. So the sloth, clinging to the tree, utterly helpless, appears so like a bunch of moss that it escapes the notice of the various eagles which delight in preying upon it.

Those of my readers who have kept butterflies and moths are familiar with the wonderful transformations through which they pass before attaining the perfect form again. The egg becomes a worm, and the worm spins a cocoon or house in which it passes the retirement necessary for the change. In the construction of this cocoon the greatest care is often taken, so that enemies may not suspect its real nature. One of the most remarkable is formed by a South American butterfly, and resembles a basket, between the bands of which is seen the pupa. From the basket extends a long silken line, in turn attached to a twig; so that the animal has actually concealed itself in a captive silken balloon. So light an object is natu-

rally being continually blown about by the wind; consequently, absolute protection, or immunity from the attack of birds is found.

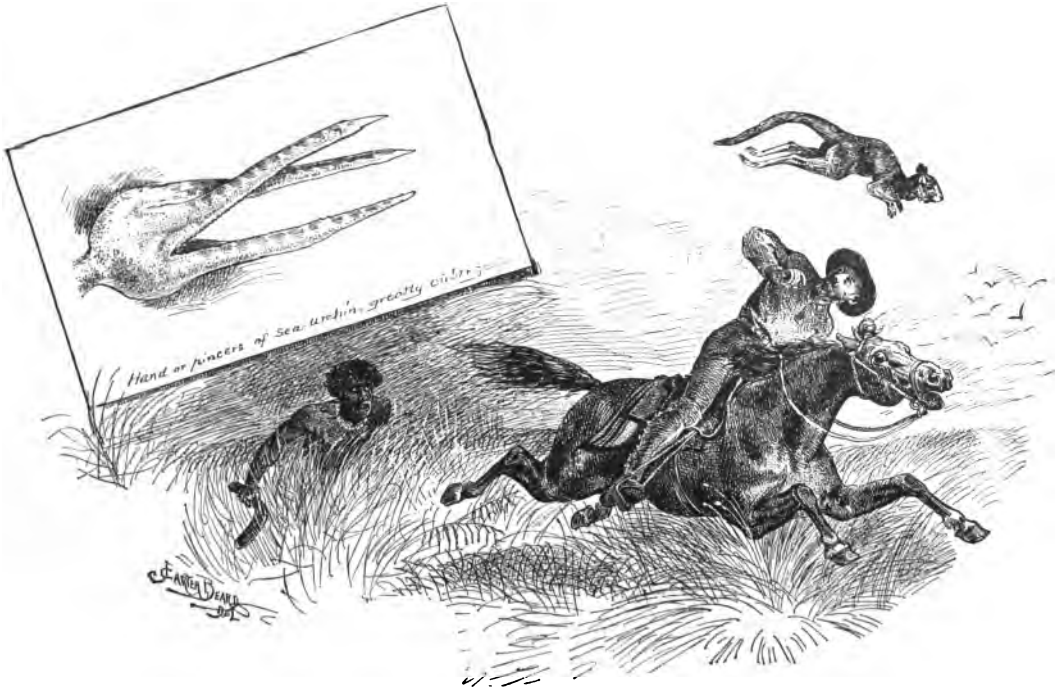
Many insects make their cocoons the exact tint of the surface upon which they are placed; and who has not seen the wonderful protection afforded the egg-case of the mantis found on fences where the exact hue of the board is simulated?

In all these instances the efforts for protection have been employed against living enemies; but these are but a few of the dangers that beset the inhabitants of our woods and streams.

Jack Frost, the advance guard of winter, warns our feathered friends that cold weather is approaching, and in their actions at this time is seen one of the most wonderful of all instinctive methods of protection. Throughout the summer days we have been accustomed to the hum of the insect life that has thronged the woods and vales; but the first frost that signals the approach of winter is a warning of their near departure. They disappear. Some crawl into the ground and bury themselves far beneath the surface; every old

root or tree being an asylum for vast numbers of forms fleeing from the winter cold. By far the greater number are doomed to destruction, and in their disappearance we see how closely all nature is bound together, as this removal of insect life, if no other provision were made, would have a disastrous effect upon the majority of the three billion birds which are supposed to populate our continent, many of whom depend upon insect food, and are threatened with starvation. The grain-eaters also have their supply cut off, as their food no longer stands in the field protected by the helpless scarecrow, but has been harvested by the farmer. So we have an army of birds utterly deprived of food. To whom can they look for protection?

Such a great problem would not be neglected by nature, and we find that birds are enabled to surmount the difficulty. This provision is "instinct;" and how wonderful it is we can only realize when we remember that it enables small and delicate birds to traverse vast areas of land and water, often from the Arctic Ocean to the Gulf of



A WONDERFUL LEAPER.

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Mexico twice a year, and to find their way back to the very tree or spot that they have previously nested in. Migration, then, is their protection from cold and hunger, and exactly how it is accomplished is still somewhat of a mystery, though many persons are engaged in studying the question in this country and in Europe.

At the first approach of winter when the food supply begins to fail, the birds show signs of unusual action. The swallows congregate in certain trees for days and sometimes weeks, as if they were holding a meeting of the Bird Geographical Society to determine upon the best route to take. Day after day these flocks are seen; then finally they will be missed, and miles away to the south they may be traced, wending their way to the lands where summer is present.

Probably comparatively few have seen flocks of migrating birds, and this is perhaps due to the fact that the journeys are made at night. This was shown in a peculiar way some time ago near one of our large cities. An astronomer was engaged in making some difficult observations, and

one night he was annoyed by what appeared to be a succession of blurs or specks passing over the glass. A careful examination of the instrument revealed that it was in good condition, and it was evident that the trouble was in the air, and after close scrutiny the black specks were found to be small birds flying swiftly at a height of over two miles above the surface of the earth.

Since then it has been ascertained that most of the migrations are undertaken at night, the bird tragedies that occur at lighthouses telling the story. Hardly a night in the spring and fall months of the year but numbers of birds of all kinds are lured to their destruction by the vivid light from the beacons that are protection and warning to human travellers. Mr. William Brewster, a Boston naturalist in charge of the bird-department in the Agassiz Museum, spent nearly seven weeks making night observations at Point Lepreaux lighthouse, New Brunswick, on the west shore of the Bay of Fundy, and the results shed a vast amount of light upon the subject, though they tell a sad story of the mishaps of our feath-

ered friends during their journeys. Mr. Brewster says in a communication to the Nuttall Club:

The first "rush" occurred on the night of September 1, and for the two weeks following, the feathered tide flowed swiftly and more or less steadily, marking its course through the star-lit heavens by the incessant chirping of its passing legions, in thick weather surging confusedly about the light, wrecking many a bird-life against the fatal shaft, and at daybreak leaving hundreds of tired little travellers stranded in the scanty covers of the Point.

This was a remarkable exhibition, but a few nights later Mr. Brewster observed from the Light a scene that few have witnessed — a veritable rain of birds which he thus describes:

At the height of the *mêlée* the scene was interesting and impressive beyond almost anything that I ever witnessed. Above, the inky black sky; on all sides, dense wreaths of fog scudding swiftly past and completely enveloping the sea which moaned dismally at the base of the cliffs below; about the top of the tower, a belt of light projected some thirty yards into the mist by the powerful reflectors; and in this belt swarms of birds circling, floating, soaring, now advancing, next retreating, but never quite able, as it seemed, to throw off the spell of the fatal lantern. Their rapidly vibrating wings made a haze about their forms which in the strong light looked semi-transparent. At a distance all appeared of a pale, silvery gray color, nearer of a rich yellow. They reminded me by turns of meteors, gigantic moths,

swallows with sunlight streaming through their wings. I could not watch them for any length of time without becoming dizzy and bewildered. When the wind blew strongly they circled around to leeward, breasting it in a dense throng, which drifted backward and forward, up and down, like a swarm of gnats dancing in the sunshine. Dozens were continually leaving this throng and skimming toward the lantern. As they approached they invariably soared upward, and those which started on a level with the platform usually passed above the roof. Others sheered off at the last moment, and shot by with arrow-like swiftness, while more rarely one would stop abruptly, and poising a few feet from the glass, inspect the lighted space within. Often, for a minute or more, not a bird would strike. Then, as if seized by a panic, they would come against the glass so rapidly and in such numbers that the sound of their blows resembled the pattering of hail. Many struck the tin roof above the light, others the iron railing which enclosed the platform, while others pelted me on the back, arms, and legs, and one actually became hopelessly entangled in my beard.

Why the birds should select the night for their migrations would seem difficult to understand, especially as if taking land-marks as their guide they could not see them as well as during the day. But during the daytime they must feed, and the presence of human enemies may prevent their passage in large conspicuous bodies; so that, as a rule, the onward march is made after nightfall.

During the fall a vast army of birds is moving South, impelled by this wonderful instinct, and undoubtedly guided by means of their habits of observation. Those who have made an ascension in a balloon to a lofty height have noticed how plainly the great natural features of the country are seen even at night. The valleys, the mountain-chains and coast-lines are easily distinguished, and the bird rivers, as they may be termed, follow these guides.

At one time for six weeks I watched the flight of the sand-hill cranes in Southern California in their Northern migration; thousands passing overhead daily, sometimes almost within rifle-shot, and again two miles above the sea, following the Sierra Madre range. Each successive flock took the same course midway between the summit and base of the range.

At this same time thirty miles west immense throngs of ducks and geese were following up the coast-line, finding there numerous swamps and marshes in which to rest and feed.

It is evident that in fleeing from the cold many

dangers are experienced, especially by the birds which follow the coast-lines. Off-shore gales often carry them far out to sea, and they are lost. Not a ship coming into port from a European cruise but can report the appearance far out from land of one or more birds, so wearied with their long flight over the waste of water that they did not exhibit the slightest fear. Sometimes it is an eagle or a large hawk, but, as a rule, small shore-birds; and the extent to which they are blown from the land is well shown in the Bahama Islands, where every spring and fall numbers of migrating birds are observed.

At Garden Key, a coral island, on the extreme outer point of the United States, in the Gulf of Mexico, I have seen many of our common birds, as the cuckoo and others. They would appear suddenly, and sometimes the trees would be filled with them, usually after a heavy norther, showing that the little creatures must have flown entirely across the Gulf of Mexico, probably from Texas or some of the Gulf States, without a rest — a wonderful evidence of their power of endurance.

Some of the smallest birds undertake the most extended flights. Thus a little warbler (*Dendroeca*) ventures in summer to the edge of the Arctic Sea, returning far South to escape the extremes of winter. Our common robins are also found there, and the regularity with which they find their way back to the orchards of their choice is remarkable. In one instance that I know of the robin returned on several successive years within a few hours of the time, and not only built in the same tree, but occupied the very limb and corner, piling a new nest upon the old until four were seen.

A gentleman who has spent many years upon the shores of the Mediterranean, informed me that he had often seen birds reach the European shore, having made the flight from Africa, so fatigued that they dropped upon the beach utterly exhausted, and could be picked up.

These migrations are taken advantage of by the bird-fanciers who frequent localities where quail are known to land. As the birds alight in flocks utterly unable to move, a net is lowered down upon them, and they are secured.

Certain birds escape the rigors of winter, and succeed, according to a European naturalist, in crossing the Mediterranean at the expense of others. A stork was the victim in the instance observed, the little birds clustering about and finally alighting upon its back, so obtaining a ride across the sea. I, myself, have seen a gull standing upon the back of a pelican while the latter was swimming about; but that a bird should board a flying stork and take free passage to Africa is certainly remarkable.

The lanes of bird migration in Europe are similar to those in this country, and on the island of Heligoland, which lies in the path of this great river of birds, thousands of feathered travellers of all kinds are often seen in the spring and fall, and at night clouds of them congregate about the Light, of such density as to nearly obscure the rays.

Among the animals which do not migrate we find some curious methods of protection. Thus the ptarmigan and several other animals change their color with the seasons; in the summer having a dark plumage or fur, and when winter comes,

and the ground is covered with snow, assuming a coat of the same pure white, making them equally inconspicuous to friend or foe.

Some years ago I received a number of crabs intended for an aquarium, and before placing them in their prison I took a stiff brush and rejuvenated them, so to speak, by removing all the sea-weed with which they were thickly covered, and in this condition dropped them into the tank, which was evidently not to their taste; being, with its four glass sides, much too bright and cheerful, and rendering them entirely too conspicuous. While watching their deliberate yet frantic efforts, for they were slow movers, to effect concealment, I became witness to a very ingenious and effective mode of protection. The crabs, one and all, crawled in the direction of a pile of moss-covered rock, and lodged themselves in the various nooks and corners; but still with their polished backs they presented a decided contrast to the rocks. While I watched them one large crab reached its long biting claw out, and with great deliberation severed a bit of sea-weed from the rocks and con-

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veyed it to its mouth. It was evident then, I thought, that they had not lost their appetites by being subjected to such unusual treatment; but in a moment more I found that the morsel was not intended as food, for it was conveyed by an overhand or claw-movement from the mouth to the back, pressed upon it and curiously enough, remaining there as if growing. Another piece of alga was then taken and the same operation was repeated, and I now saw that all the crabs were diligently at work in the same way; in short, were forming a plantation of sea-weed upon their backs, thus rapidly creating a resemblance between themselves and the moss-covered rocks among which they were hiding. In a remarkably short space of time the resemblance was complete, and they were effectually concealed, and few hungry fishes would have suspected that beneath these waving branches rested a good breakfast.

The severed portion of the weed was undoubtedly pressed to the mouth to receive some gelatinous substance that effectually cemented the branch to the back, where it grew and flourished.

On many Japanese articles is figured a little turtle which finds protection in a similar manner. It was once my good fortune to see one of these little oddities. It was called by its owner a hairy turtle, the hair being a long graceful train of dark-green sea-weed that almost completely concealed it; giving it a very peculiar appearance when swimming (which it did with difficulty) and serving as a perfect disguise or protection.

Quite a number of animals seek to mislead their enemies in this way. One, a large univalve, selects shells and fastens them to its own so firmly that they become a part of it. Various worms in a like manner decorate or embellish their tubes; working in bits of shell and weed that afford them a thorough protection.

The common star-fish of the Eastern shore, and particularly the echinus, has a habit of piling bits of shell upon its back or spines, probably as a concealment; yet the little creatures are extremely careful to prevent the advance of an enemy, and if a bit of foreign matter becomes lodged on the spines it is very quickly removed. How this is

possible when the echinus is without hands is somewhat of a mystery; but if we apply a powerful glass to the surface of the animal we shall see numbers of pincer-like bodies, called pedicellariæ, among the spines. They are really hands, or three-jawed pincers mounted on short stems, and their purpose is to free the surface of the echinus of any disagreeable intruder. Such an object is seized by the little calcareous jaws, passed down from one to the other and finally dropped off.

The efforts of animals in protecting each other would form an interesting chapter. An injured gull has been seen borne off by two comrades out of reach of a gunner; the two friends each taking their wounded companion by the tip of the wing, and so flying away. A hawk has been known to dart at a boy's kite and tear it in pieces, thinking it some enemy that menaced its mate or young.

And so throughout all nature we find that while the various animals are destined to prey one upon another, they have been provided with means of protection and defence generally sufficient to equalize the struggle for existence.

CHAPTER VII.

FEATHERED SENTINELS.

THE GUARDIANS OF THE MOOSE.

O some our feathered friends appear to have no avocation beyond adding to the attractions of field and forest with their song, the grace of their flitting forms and the beauty of their plumage; but all birds have a certain work to perform, and for this they are perfectly adapted and gifted.

In their relation to man their importance can hardly be overestimated. They are the allies of the farmer and horticulturist. Even those considered depredators often carry seeds from one

locality to another, thus assisting in planting and rendering populous areas which without vegetation would fail to support human life.

Without dwelling upon this phase of bird-work I may mention one instance showing the amount of seed-transportation that is thus carried on. Some years ago the Dutch government at the Moluccas decided to destroy all the nutmeg groves except on the island of Great Banda. This was carried into execution; but the next year, to their surprise, they found myriads of new trees shooting up all over the islands. Investigation showed the new forests to be growing from seeds carried by fruit-pigeons from Great Banda, and every year after this the government was obliged to send out a commission to the islands to destroy the seedlings thus planted. The birds not only transported nutmegs, but coffee and other seeds; and in various parts of the world we shall find that they have been a prominent factor in rendering barren localities habitable for man.

To show some of the curious relationships that exist between birds and animals in entirely differ-

ent walks of life is the purpose of this chapter. One of the most interesting of these is the guardianship exercised by certain birds over various large animals, the latter admitting a familiarity that is often obtrusive, but permitting it, well knowing that the birds are their friends. Of the several benefits obtained by the larger animals from this association is immunity from surprise; the birds being veritable sentinels, standing guard with all the vigilance of veterans, and announcing loudly to their lordly companions the slightest semblance of danger.

In Canada, and occasionally in the northern part of Maine, is found the great moose, prized by the sportsman as a trophy, and hunted for food by the woodsman of the far North. Once when a party of hunters were following a trail in the northern country, they observed the tracks of one of these animals and began carefully to trace it, hoping to secure the great game. They moved slowly on for some time when suddenly they were startled by a number of Canada jays which rose into the air, fluttering their wings, and uttering

discordant cries. Their motions were so remarkable that the hunters stopped, thinking that perhaps the birds were engaged in a battle, and being naturalists they wished to see the result. As they took seats upon the ground the birds all suddenly dropped together.

Determined to learn the occasion of this manœuvre, one of the hunters made a detour, and ascended a rock which overlooked the spot. As he peered over the edge he saw to his astonishment an enormous moose lying upon the pine needles evidently fast asleep, while all about, upon its horns, ears, and back, the large birds were standing or running about. He watched the performance for some minutes, and then having a fair shot rose and prepared to fire. But the warning of the sentinels proved effectual, for at the same instant the moose sprang to its feet and dashed off, escaping the ball intended for it.

In Central America wild cattle are attended by a curious bird called the ani, which performs for them a similar service, often clinging to them in great numbers. As they have a singular habit

of tipping up their tails and assuming various attitudes expressive of surprise or other emotion, the back of an ox frequently presents the appearance of a mimic stage, upon which feathered acrobats or contortionists are performing their feats.

It is in Africa, the Dark Continent, that we find the most remarkable examples of this phase of bird-usefulness. In this wonderful country of mystery and surprises have been found many large animals attended by remarkably vigilant sentinels, and where the great game is hunted by man they are of exceeding value to their huge consorts.

One of the most familiar birds which seem born sentinels, is known to naturalists as Buphaga, the common name being ox-biter or ox-pecker, from the belief of the natives that the birds nip and bite their oxen, which they undoubtedly sometimes do. One of the most attractive of these feathered sentinels is the red-beaked ox-biter, *Buphagus erythrorhynchus*, a bird about the size of our common robin, a little larger, and more robust, and withal a very jaunty fellow, with a red beak, as its name indicates, and a sharp eye of flaming gold;

even the eyelids partaking of the vivid hue. Its back feathers are a grayish-brown, while the under ones grade to a light yellow. For generations these birds have acted as sentinels to such large animals as the camel, ox, hippopotamus, elephant, and especially the rhinoceros, one of their names being "the rhinoceros-bird;" and while we may appreciate the little creature's attempts to protect and warn their great friend they are a source of great annoyance to the hunter, who, after following an animal for hours over a rough country, under an equatorial sun, finds that he has been spied out by the sentinel who gives his warning, which, like the "all's well" of the human soldier, is passed from throat to throat — only in this case it is "all's wrong!" — until a perfect chorus of cries warns the rhinoceros to be off.

The rhinoceros-bird, when upon the white species, presents a curious contrast. Sometimes a flock of two dozen are seen running over its body; clinging to the tail or ears, or upon its sides like a woodpecker to the bark of a tree, the rugosities of the animal's hide affording an equally fine cling-

ing surface. Oftentimes they perch upon the horn of the animal, and again both horns and the ears are utilized by the sentinels as perches. This bird is frequently seen upon the Cape ox, which is considered one of the most dangerous game-animals in Africa. They not only follow them, alighting upon their horns, heads, and every available portion, but when a herd of tame cattle are unharnessed and released, the birds, which have been watching proceedings from some neighboring tree, pounce down upon them, and soon each ox has its quota of vigilant sentinels, and they have again and again been known to warn the tame animals of the approach of lions, and so saved them. New cattle, which have never been into the interior, are often alarmed at first at this seeming attack of birds, and rush about, tossing their heads to avoid them; but as soon as they discover that they intend no harm they submit quietly to their presence.

It would be only natural that other animals besides those which permit the birds to alight upon them, should take advantage of the warnings.

Drummond, an African traveller, records an instance of this. He had been following a water antelope which was sorely needed for food, for some time, and at last had reached a spot where he expected to obtain a shot; but as he crept along followed by his attendant he was suddenly espied by a group of red-beaked rhinoceros-birds, which were sitting on the head of a Cape ox not far off. They at once rose in a body, shrieking and screaming their harsh warning cry of "*tcha, tcha.*" It was heeded first by the water antelope, concealed near by, which dashed off, the Cape ox quickly following suit.

The benefit of this bird-guardianship to these animals can hardly be estimated, as even when awake a native hunter could by careful manœuvering approach them from leeward, and when asleep could draw near with perfect security were it not for the feathered guard.

That the birds have some attachment for their huge friends there can be little doubt, and the account of hunters reminds me of the fish remora ...h I have often taken when catching sharks in

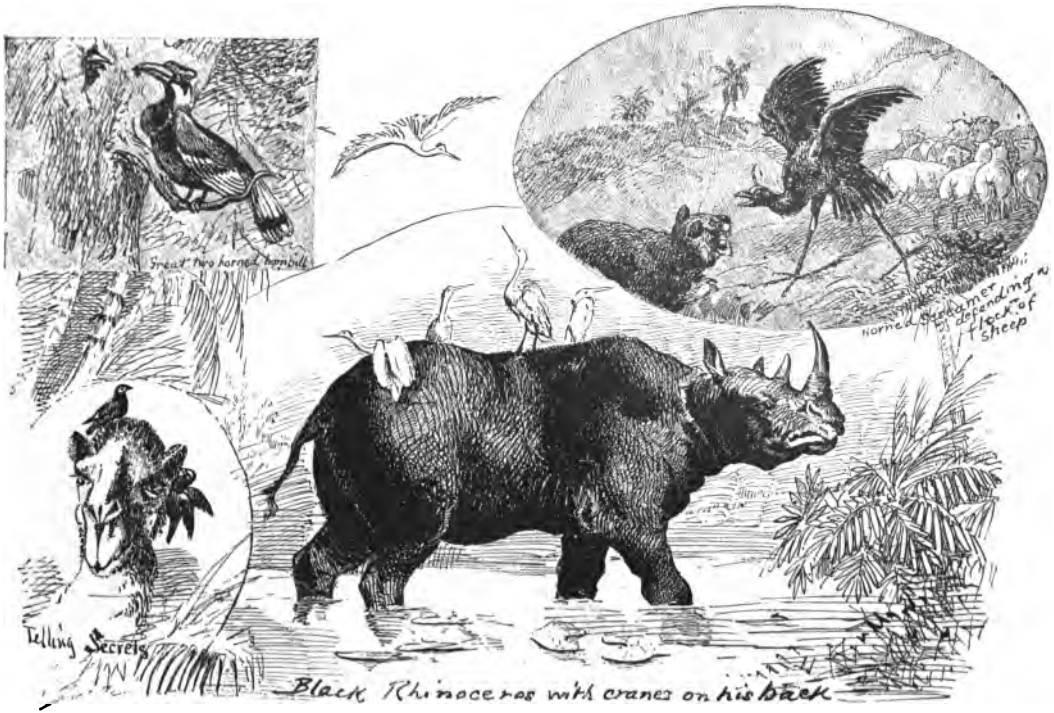
Southern waters, the attendant fishes fastening themselves to their great consort, and allowing themselves to be hauled entirely out of water with it. So with the rhinoceros-bird. In an instance where a rhinoceros was chased for some time by a hunter on horseback, the birds not only followed on, but clung to the creature's hide, though repeatedly brushed off by the trees; and when the animal was finally shot they remained near. When the hunters approached the next morning the faithful little creatures were still clustered about their dead companion, and as the natives drew nearer, they brushed their wings in its face, and used every endeavor to awaken it, evidently believing it asleep, and retiring only when the men took possession.

Besides the ox-biter a small white crane often alights upon the back of hippopotami, rhinoceroses and elephants. A dozen or more of these beautiful birds have been seen standing upon the back of an animal in the middle of a river; their eagle eyes alert for any possible enemy that might appear. They utter no sound when danger is nigh,

merely rising; the flapping of their wings being a sufficient warning. The contrast between these pure white birds and the dark skin of an elephant or rhinoceros is very marked, and is a sight to be seen only in the solitudes of the Dark Continent.

The wattled starling is almost equally valuable as a sentinel, clinging to the sides of cattle, and uttering vigorous protests at the approach of an enemy or intruder.

It would seem quite remarkable that birds should act as sentinels to large quadrupeds; but, stranger yet, we find several which appear to hold this office in the interests of their own kind. An interesting instance was observed by a naturalist in North Africa. He was wandering through the forest in search of game, when he noticed a large number of beautiful copper-colored fly-catchers (*Lamprotornis*) dart into the air, uttering loud cries. Concealing himself, and peering through the bushes, he witnessed a most ludicrous and strange sight. The open place beyond him was filled with a larger body of storks, *Sphenorhynchus abdimii*, grave, grotesque fellows, each of which



FAITHFUL SENTINELS.

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bore upon its back or head a copper-colored little bird, which every now and then darted to the ground, immediately returning to its perch. The large birds were moving solemnly along in a regular phalanx, each with its rider, their object being the locusts which they devoured as they marched. After watching this curious sight for some time the observer showed himself in the bushes, when the fly-catchers gave the warning, and big birds and little immediately took wing and flew away.

In South America we fine a curious bird, the spur-winged chauna, *Chauna chauvaria*, which is not only a sentinel but when domesticated a veritable watch dog; showing remarkable pugnacity when the safety of any of its friends is threatened. Its voice is so loud, discordant, and piercing, that it is called "the screamer." Its cry alone is sufficient to demoralize an ordinary enemy, but besides this, the screamer has a wonderful defence — two spurs, or horns, upon each wing, pointing forward, with which it can strike a powerful and lacerating blow. The natives of South and Central America recognize this peculiarity in the bird, and take it

when young and bring it up in the poultry-yard where it forms an efficient guard against hawks and other predatory animals. It will not retreat even before the puma; advancing with such a ferocious mien that even the great cat is often routed. Shepherds employ them about their flocks, and several "screamers" have been seen standing before a lamb which was threatened by a puma, and by their screams awakening the shepherds from their siesta to come to the rescue.

Some years ago a story was reported by a naturalists which taxed the credulity of every one who heard it, describing the actions of a feathered sentinel. The story was that the great hornbill, the grotesque bird with enormous beaks, so familiar in all collections of African birds, imprisoned its mate at certain seasons, and became a self-appointed sentinel. This is now known to be true; and not only of one species but several, in Africa and the East India Islands. When the breeding-season approaches, the female seeks a suitable location for a nest, generally in a hollow tree. In this some feathers, and perhaps twigs,

are placed to make a rude nest, and here the female bird takes her place. No sooner has she stepped into the home of her future brood than her mate proceeds to wall up the opening by bringing mud and earth in its capacious bill. This is plastered on, bit by bit, much after the manner of the swallow, until the hole is closed up completely, with the exception of a small orifice through which Madam Hornbill is to receive her food. The partition soon hardens in the sun, and the bird is a prisoner, guarded by the male who perches upon a convenient limb; and let no one accuse him of neglecting to supply his mate, as by the time the term of imprisonment has expired he is in a doleful condition physically, having to provide a double portion of food, and often sacrificing his own to the wants of his ravenous mate. This surveillance is kept up until the young hornbill is hatched and partially fledged, when the nest is torn away and the mother emerges.

In the case of a two-horned hornbill, *Buceros bicornis*, observed by Mr. C. Horne, the female closed up the orifice from the inside with material

which she had brought up from the bottom of the hole. The plastering was done by using the bill sidewise, back and forth, like a trowel. There was no limb near the hole for the male to alight upon, so he clung to the bark in feeding her like a woodpecker. While the hornbills have short wings they make a remarkable sound in flying; in fact, one can be heard a mile away, and several make a noise like a steam engine.

The natives have long been familiar with this habit of the hornbill, and readily recognize a tree containing a nest by the wall built over the hole, which, however, is so skilfully done that it readily escapes the notice of a European. This domestic drama sometimes ends in tragedy, as it not unfrequently happens that the male bird is so completely exhausted by its efforts to supply its mate with food that it falls a victim to rigorous weather and drops dead at the door of its home, thus serving as a telltale to some passing native, who, glancing up, espies the nest, and soon captures the plump and unwieldy mother-bird.

The hornbills are remarkable creatures even in

appearance. The body is large, legs and neck rather short, and the coloring sombre, except the tip of the wing and tail, which are white. They vary in size, the largest being as large as a hen turkey. The head is the most remarkable feature, being provided with a bill so prodigious that one might well believe it to have been intended for a bird of prey, instead of a simple fruit eater. The so-called horns are enormous cellular horny growths upon the head, which in some species give it the appearance of having two bills. So loud and resonant is the voice of this bird that it was supposed at one time that the sound was accelerated by passing into the "horns." But this has no foundation in fact; the growth being merely a part of the ornamental configuration of the bird, perhaps intended to frighten its enemies by giving it a formidable appearance.

In riding over the mesa of the San Gabriel Valley (Southern California) I have often encountered a bird which if not a sentinel is a soldier or engineer of such remarkable sagacity that it deserves mention here. When I first observed it,

I was galloping through some sage-brush interspersed here and there with prickly pear, and the bird darted out directly under my horse's feet, and ran along so near that at first I thought I could catch it by reaching down from the saddle. But as I increased my speed, so did the bird, and soon we were in a wild race; the bird running with remarkable celerity, keeping in the clearing for some distance, but finally when closely pressed taking to a dense patch of prickly pear, at the edge of which I reined in my horse and gave up the chase; and though I have seen it stated that the bird can be run down on horseback I doubt if it can be done in the San Gabriel Valley.

The bird was the chaparral cock, or road-runner, *Geococcyx californianus*, one of the most attractive birds in its strange markings found in this country, having a curious bald orange-colored spot back of the eyes which are remarkably fierce and brilliant. I was familiar with the current story of the road-runner which I rather doubted, but I succeeded in finding two persons of veracity who confirmed it. It seems that the bird in certain parts of the

country builds its nest in the vicinity of the cactus or prickly pear, and as it entertains a morbid antipathy to the rattlesnake, and also esteems it as an article of food, it endeavors at every opportunity to destroy it, and in the following way, as described by my informant. In the instance he observed two birds, evidently male and female, were at work. They had found a sleeping and coiled rattlesnake, and were busily engaged in dragging the large spine-covered leaves of the prickly pear toward and arranging them about it in a circle, making what in the Southwest is called a corral. My informant watched the birds for some time, and finally when the snake was in the midst of a perfect hedge of spines, one of the leaves was purposely or accidentally pushed upon the reptile which lifted its head and savagely struck out and was immediately pierced by the needle-like spines. This added to its rage, and again and again it struck, each dart only increasing its agony, so that it writhed about, and was soon involved in a maze of the terrible darts, transfixed and stabbed from every point, so that finally in

very desperation it turned and bit itself repeatedly until it died.

My other informant, a surveyor who had travelled over the country for many years, had not witnessed the act of piling up the leaves, but he had found many of the cactus-corrals and the skeleton of the snake in the centre — a monument to the cunning and daring of the road-runner.

This act shows remarkable intelligence in this bird which is not quite as large as a crow, since it must associate in its mind the result that will follow the contact between snake and cactus spines.

The famous secretary-bird of Africa has been employed as a sentinel in the French West Indies, where it was introduced a number of years ago to prey upon the rattlesnakes which had increased to an alarming extent. The birds attack these reptiles with great avidity, being safe on their great stilt-like legs from their darts. Many planters in the French colony keep the birds about their grounds, where they become perfectly tame, standing about, always on the watch for enemies from the reptilian world.

All the previously mentioned birds, it will be noticed, use their faculties to protect something or somebody, in time of danger; but as in the human family, there is always a traitor, one who for selfish ends will expose the home or store of another, and in the feathered tribe this traitor is the honey-guide, *Indicator Albirostris*. This bird is extremely fond of honey, as its name signifies, and unable, as a rule, to enter the trees itself it makes the most astonishing advances and signs to human beings in its endeavors to induce them to open the hive. I cannot do better than quote Mr. E. F. Sandeman's account as the latest and one of the most interesting:

A small gray bird with a reddish beak, the size of a sparrow, had flown alongside and round the wagon, making a shrill harsh cry, and sometimes almost flying in the faces of the drivers; and I noticed that the boys were regarding it with peculiar attention, and talking among themselves in reference to it. On asking what caused the unusual interest in, to all appearance, a very commonplace bird, it was explained that this little, insignificant visitor was the far-famed honey-bird. As soon as the oxen were outspanned and the boys at liberty, three of them, armed with buckets, spades, and hatchets, set off toward the bird, which had flown to a

neighboring tree as soon as it perceived that our attention was successfully attracted. A—— and myself, to whom it was as strange an adventure as it was novel, accompanied the boys. As soon as we reached the tree the little fellow had perched on, it flitted to the next, and then on again until we came up. For nearly a mile this was kept up, and as the way grew more difficult and the bushes more dense, our own faith in the bird was rapidly giving place to irritation at what began to look very like a trick of the others at the expense of our inexperience. At last the bird stopped altogether in a small clump of some dozen mimosa-trees, all growing within a few feet of one another. When we came up to it, instead of, as heretofore, flying off in a straight line, it just flitted to an opposite tree, remained there a few moments, and then back to its previous position. This was its signal that the nest was close at hand. The boys examined the trunks of the trees round most carefully, but could find no opening where the nest could by any possibility be situated. The bird grew more and more angry and indignant at what it evidently considered our extreme stupidity, and flapped its little wings and redoubled the shrill cries which it had ceased to utter while leading us to the spot. At last, losing all patience, it actually settled on a piece of the stem of one of the trees it had been persistently flitting backward and forward in front of. The boys, now paying more attention to this particular tree, perceived just above where the bird had perched a small hole, and round it a kind of cement. While we were watching, a bee flew out, which made it certain that the nest was within the trunk. The driver of Wordward's wagon, who was an old hand at the work, at once climbed up the tree with a hatchet, and under

his direction the others collected armfuls of dried grass. Taking a large handful of this, he lighted it, and then struck with the hatchet at the mouth of the narrow hole. At the first blow a quantity of mud, wax, and decayed wood fell to the ground, with which the bees had skillfully walled up a large portion of the decayed wood. Out swarmed a cloud of bees, and now his burning grass came into operation. As quickly as they flew out their wings were singed in the flames, and they dropped helpless to the ground. In a very few minutes, all the occupants of the nest were destroyed; but new comers were constantly arriving, which made close quarters anything but pleasant, but much cutting was necessary to lay bare a large portion of the combs, which were laid horizontally across the entire width of the hollow portion of the tree. Before leaving we carefully fixed a comb filled with honey on the nearest bush, and our late guide flew down and commenced his well-earned repast as soon as we had turned our backs on the spot. The Kafirs would much prefer not to take any honey at all, than depart with their spoil and not leave a portion for the bird. They firmly believe that if they thus defraud the bird of its just rights, it will follow them up, and at a future time, instead of leading them to honey, will entice them into the lair of a lion, or to a nest in which some deadly snake lies concealed.

The honey-guide does not always lead hunters to honey. One persistently flew about Drummond, the African trader, darting in front of his face, until it almost forced him to follow, then after

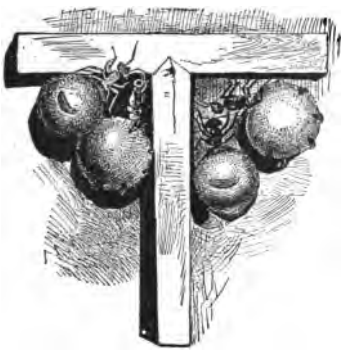
taking him over a rough country led him into a dry water-course, and there pointed out a huge snake — in this case acting as became a sentinel.

On another occasion the same hunter was troubled with the unceasing attentions of one of these birds, and finally after following the little creature for half a mile, expecting every moment to see a leopard or lion which had excited the bird's ire, it led him to a tree, at the foot of which he was much surprised to find one of his hunters who was fast asleep instead of being off at work as he had been ordered.

We sometimes hear in this country of secrets being whispered by little birds, and it would seem to be a reality in Africa.

CHAPTER VIII.

ANIMALS AND THEIR FRIENDS.



LIVING HONEY-BOTTLES.

THAT the lower animals have their special friends, or show preferences as to their companions, no observer can doubt. In some cases the friendship is between two of the same tribe; again we find what are generally considered the most antagonistic forms united in bonds of good-fellowship, and we see acts of devotion and self-sacrifice that are almost identical with those that characterize the friendships of human beings. It is needless to say that

the impulses are much the same in all; some professing an interest that is actuated entirely by greed, or for personal ends, while in others it is unselfish.

Any one who has visited the herd of elephants owned by Mr. Barnum must have noticed the large dog that stood by the side of one of the huge pachyderms. To the visitor this might have seemed accidental; but the dog was always at its post by this particular animal. If the dog wandered off the elephant showed its distress immediately by attempting to follow; straining at the chain confined to its ponderous feet, or throwing aloft its trunk and uttering the shrill whistle indicative of alarm, and only resuming the monotonous swinging of the head when its companion returned. The elephant was often observed caressing the dog, and though the latter always slept in the straw, sometimes beneath its huge friend, it was never stepped upon or crushed. When the elephant was led out to go through its daily task in the ring, the dog would begin to bark and endeavor to join the throng of performers; so that it was perfectly evident that the friendship was mutual.

In many of the works of old writers are found instances of such attachments between man and beast. Ælian records a friendship between a little girl, who sold flowers in the streets of Antioch, and an elephant which she was in the habit of feeding. One of the elephants in the Barnum herd exhibited great interest in a little daughter of one of the attendants; holding her upon its trunk, and in many ways showing its affection.

In India elephants are so trusted that they are sometimes employed as nurses, and have been seen carefully tending their charges, lifting them gently back when they were disposed to stray away. The natives state that these great animals have been known to die of a broken heart when deprived of a certain keeper, and Lieutenant Shipp, an English officer of extensive experience in the East, gives a minute account of an elephant that died in what was considered a fit of remorse after having killed its keeper.

While attachment between animals is everywhere to be seen, it is not often that we witness such acts of disinterested devotion as we expect

among human beings. Mother-birds protect their young in the face of every danger; but it must be confessed that few observers have seen animals go to the rescue of others without maternal or paternal incentive; but such cases are not wanting.

Some years ago a Scotch naturalist wishing to obtain a gull fired at a flock, breaking the wing of one which came fluttering down, falling into the ocean. At first the flock were demoralized, and flew wildly about, uttering harsh cries; but a moment later they seemed to be recalled to a sense of duty by the struggles of their wounded comrade, and two birds darted down, seized it by the tips of its wings, then rose and bore it away in triumph; for, as may be supposed, the naturalist did not fire, but permitted the rescue. Here was friendship indeed; heroism, in fact, as the other birds alarmed by the fire faced the same danger.

Among the fishes we find some curious instances of companionship. I have seen a large man-eater shark moving slowly along the side of a southern channel, accompanied by two sets of companions. One, and the most prominent, were remoras, slen-

der black fishes about a foot in length, bearing upon their heads a curious sucker formed of plates. Usually these attendants swim by their great consort, offering a striking contrast to it, occasionally straying off. If the shark is alarmed and increases its speed, they turn quickly, and fasten their suckers to it, and are so towed along. I have, with the assistance of a dozen men, hauled large sharks upon the beach, and found four or five remoras still clinging to its sides.

If a man-eater is watched closely in the water the other companions will be observed about its head; little striped fishes known scientifically as *Naucrates*, and popularly as pilots.

According to the sailors the little fishes spy out food and inform their huge friends; but this story has its limitations, and arose from the fact that the fishes are nearly always seen darting about in search of food. I have seen them twenty feet from the shark, swimming around objects at the surface, inspecting it inquiringly, and then returning to the man-eater that did not turn in that direction unless it noticed the object that had

attracted the attention of its little companions. When the shark is taken from the water they show great distress; swimming about here and there, apparently at loss what to do, finally joining their fortunes with some new friend. This is a protective measure on the part of the smaller fishes. They doubtless know that here they are safe, and in many that I have watched their presence was not noticed in any way by the sharks. I have seen the remoras accompany a large porgy, and also cling to a loggerhead turtle; and doubtless they follow all the large slow-swimming fishes.

The huge Lophius, or American angler, which has such a wide distribution in many seas, presents in some cases an interesting example of an association more or less friendly. In a specimen taken in the Mediterranean, a little eel-like fish was found tucked away in its gills; and as several were afterward found with similar companions it was evident that the fellowship was not accidental.

The typical happy family is evidence that animals of totally different kinds will affiliate together. I have seen a ground squirrel and owl occupying

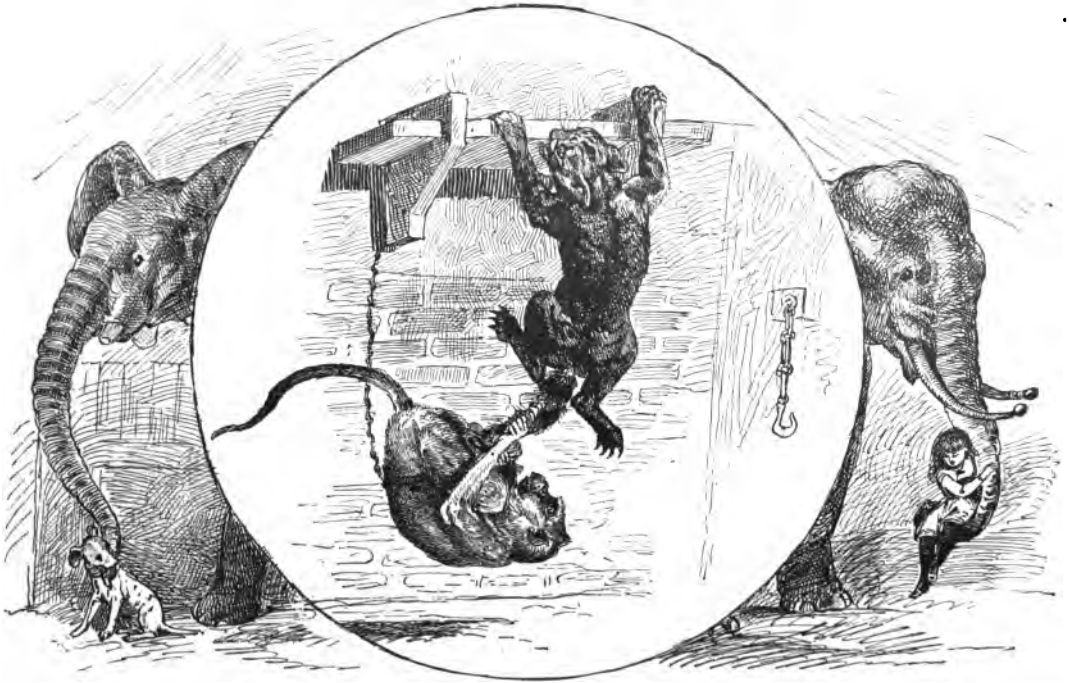
the same burrow, and the owls will live in the same house with the rabbit in Southern California, while a not so welcome guest is the huge tarantula that sometimes creeps in out of harm's way.

I once formed the acquaintance of a monkey that pretended to be on terms of the greatest friendship with a cat, the two being inseparable. When I first saw the former it sat on a shelf made for its comfort, holding the cat, that was purring loudly, tightly in its arms. Puss was in one sense a victim, and I am confident if I had tugged at her tail as her friend Jacko did I should have been rewarded after the fashion of cats; but she suffered the greatest indignities from his hands, and on one occasion only did I hear a cry of protest. She was released by Jacko, and leaped upon the shelf leaving her tail hanging down, when with a spring he seized it, and began to gyrate violently upon the living swing that uttered piteous howls in protest. But a moment later she was rubbing against him with every evidence of affection.

In the Museum of Natural History, Central Park, New York, there is a mounted African lion,

the work of the celebrated Ferreaux of Paris. The noble animal is represented as on the alert with its mouth open, the teeth glistening, and the tail in a life-like position, as if caught in an attempted lash. Everything about this specimen betokens life and action, and just beneath its head lies a little black and white dog, gnawing a bone. The picture, for it is one, is simply that of a little dog eating its dinner guarded by a lion; and while it conveys little significance to the casual observer it is a representation of actual facts; the lion and dog being old friends that lived together in the Paris Garden. The lion was so attached to the dog that it would allow no one to touch it; shared its meals with it, in itself a remarkable act as any one can realize who has watched the ferocious struggles of these animals when feeding. But this little dog had in some way secured a hold upon the great cat's affections, and was preserved and protected until the end.

An exactly opposite case was seen at the New York Zoo some years ago, when the old dog Fan adopted and brought up a family of lions.



GOOD FRIENDS.

That friendship exists between insects is well known. Especially is this true among ants, and it is surprising how quickly these little creatures recognize the presence of an intruder. At Colorado Springs the surrounding country is marked in a very noticeable manner by the ant-hills, some of which are a foot or more in height. I often visited them, and spent considerable time in watching the ways and habits of their inhabitants. If a stick was thrust into a large nest thousands of ants would rush out to the attack, and their numbers in a single nest may be realized when I say that I have swept them back with a bit of weed so that they formed at the bottom of the pit a solid mass almost as large as my closed hand. Such a ball must represent many thousands, yet all are friends or acquaintances. It is said that Napoleon knew all his soldiers, but here are ants that undoubtedly have less to distinguish them than human beings, that recognize untold thousands constituting their tribe.

That this is so I have often demonstrated by dropping among them an ant to all intents and

purposes alike, but from another nest. The recognition of a stranger is immediate, and the intruder is at once attacked and either killed or driven out. In a nest near my house the ants from frequent visitations became extremely savage and would at once attack a new-comer. One day I dropped a huge iron-jawed black ant in among them. In a second it was seized by legs and antennæ by as many of the furious host as could crowd about. At first the giant struggled, then finding escape impossible he began leisurely destroying his tormentors, every movement of the ponderous jaws resulting in the decapitation of a victim, until finally he actually secured his release.

As in nests of *Formica pratensis* it has been estimated that there are often half a million individuals, it is evident that the memory of the ant is remarkable. Some interesting experiments may be tried to prove that friendship exists between ants and that old acquaintances are not forgotten. If an ant from a certain nest is taken away and kept for a day or so and then dropped among the

rest with a stranger it is not molested, but the stranger will be found soon after badly used if not dead.

The length of time that ants will remember friends has been determined in an interesting series of experiments by Sir John Lubbock. In August, 1875 he separated a colony of *Formica fusca* which he had kept for some time. Eight months later he took one of the ants and a stranger and placed them in the old colony. The long-absent ant seemed perfectly at home and was not disturbed, while the other was immediately attacked. Ten months after the original separation he returned another old friend and a stranger. The latter was at once seized by the antennæ and dragged from the nest while the former was not molested, though it was noticed that it did not mingle freely with the family. This experiment was repeated many times, the returned ant being marked with paint so as to be distinguished, and not only was it unmolested, but its old acquaintances insisted upon removing the paint. Sir John concludes his experiments with the following:

Friends were in most cases amicably received even after more than a year of separation; but while the strangers were invariably attacked and expelled the friends were not always recognized, at least at first. It seemed as if some of the ants had forgotten them or perhaps the young ones did not recognize them. Even, however, when the friends were at first attacked the aggressors soon seemed to discover their mistake, and friends were never ultimately driven out of the nest. This recognition of old friends after a separation of more than a year seems to me very remarkable.

The friendship of ants is not confined to its own kind, but includes a variety of insects, many of which, however, it must be confessed serve them in various ways. Such are the many species of *Coccidæ*, *Cercopis*, *Centrotus*, *Membracis*. The little yellow ant, *Lasius flavus*, is particularly friendly to the *Aphis*, going so far as to exceed the bonds of friendship and using them as domestic animals, keeping them in flocks and herds. Between the ants and *aphidæ* there is a mutual accommodation society. The aphidæ supply their friends and owners with a secretion called milk, while the latter protect them from the attacks of various enemies, and even go so far as to build sheds of earth over them. Not only do they protect the

adults but they collect the eggs and care for them tenderly, taking them underground into the lower portions of their nest in cold weather, and when the young hatch carrying the offspring out and placing them upon plants suited to them — a most remarkable example of forethought, as the ants thus save eggs that will provide them with food six months later.

In some nests of the yellow ant as many as five species of *Aphis* have been found, and Märkel, a careful observer, states that in a large ant's nest (*Formica rufa*) there may be at least a thousand other insects living there as visiting friends unmolested by the rightful owners. André gives a list of five hundred and eighty-four insects found habitually associating with ants, five hundred and forty-two of which were beetles. That a friendship or association of some kind exists between this horde and the ants there can be no doubt, as the ants pay no attention to them, and just what this relationship is will form an interesting study for my young readers.

It is evident at the onset that different insects

are on different footings. Thus while the *Aphidæ* are carefully tended by the ants, an insect allied to *Podura* is often found in the galleries darting about, bustling here and there, walking over the ants with a daring recklessness, its antennæ vibrating as if with the most intense excitement; yet to this busybody the ants pay not the slightest attention. Perhaps they know that it is harmless, for *Beckia*, as Sir John Lubbock has named it, has paid dearly for its subterranean life and is blind.

Another blind friend of the ants is the beetle, *Claviger*, and not only is it sightless, but it seems to have entirely lost the power of caring for itself, and is even fed by the ants; and that they entertain some affection for the helpless creature is very evident, as they are often seen caressing it with their antennæ.

It is barely possible that these attentions of the ants are not so disinterested as one might suppose, as if the two are watched the ants will occasionally be seen to lick certain tufts of hair at the base of the elytra of the beetle, evidently obtaining much satisfaction from the act, so possibly

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the blind insect provides them with nourishment of some kind. Ants have been seen licking tufts of hair on the beetle *Dinarda dentata*. On one occasion some ants were feeding upon sugar when a friend, the beetle *Lomechusa*, came along and tapped an ant upon the head with its antennæ—a gentle hint to share the delicacy, and it was at once taken, as the ant opened its mandibles and fed the beetle as it would one of its own tribe.

In no branch of the animal kingdom are there offered so many remarkable analogies to the acts of human beings as we find among the ants. Indeed this is so marked that Sir John Lubbock says:

> The anthropoid apes no doubt approach nearer to man in bodily structure than do any other animals, but when we consider the habits of ants, their social organization, their large communities and elaborate habitations, their roadways, their possession of domestic animals, and even in some cases of slaves, it must be admitted that they have a fair claim to rank next to man in point of intelligence.

I have referred especially to ants in this chapter as they are available to all for study and observation, and while their structure and general features are well known, their domestic relations,

their means of communication and social organization present an inexhaustible field for workers.

If evidence were wanting that certain ants voluntarily make sacrifices for others the case of the honey ant would be sufficient. That ants should keep domestic animals and perform the hundred and one intelligent acts that they do is remarkable, but that certain members of a tribe should either by election or selection constitute themselves actual living bottles or reservoirs for the rest seems beyond the range of possibility; yet such is the case. Many years ago a French naturalist, Mr. Wesmael, described a Mexican ant, *Myrmecocytus Mexicanus*, which was brought from Mexico by M. de Normann, making the remarkable announcement that in the division of labor certain ants were literally living honey-jars, or storehouses, for the others. This statement was deemed incredible at the time, but was confirmed by many observers as Lucas, Edwards, Saunders, Black, and others.

Two different genera are now known, one *Camponotus inflatus* from Australia, and the one already given which ranges from Mexico up to

Colorado Springs where in the Garden of the Gods they have been carefully studied by Dr. McCook. In this locality the nests of these ants may be observed as small elevations over the ridges of disintegrating rocks that form the characteristic of this wonderful garden. If we dig down, and with hammer or axe cut into the stone, we shall find in all probability among the swarm of ants several kinds and one remarkable for its enormously distended abdomen. This is one of the workers that by agreement, or in some way, has consented to hold a supply of food for the rest. These living bottles are kept by the other ants in a room by themselves, and are generally found clinging to the wall of their cell utterly helpless. Dr. McCook found by carefully watching them that these ants were chiefly night-workers, starting out in the evening about seven o'clock, and marching in lines to some low bushes in the vicinity. Examination showed that they were clustering about the small galls, formed by the gall-fly, *Cynips quercusmellariæ*, from which they obtained their honey. Each ant upon taking a supply re-

turned to the nest and there delivered it up to the ants with the large abdomens who received it, holding it in bond, as it were, until wanted by the others. When the workers desired food they touched or caressed the living jars with their antennæ upon which it was produced by muscular contraction of the bottles and taken from their mouths by the hungry workers.

The nests contained on an average about two hundred of these honey-bearers, representing about one fourth of a pound of honey stored in this remarkable way. In Old Mexico strangers are sometimes presented at dessert with pellucid globes of honey to be eaten as we would eat a grape, the delicacy being the honey ant that is considered a *bonne-bouche* by the Mexican epicures. The honey is believed by natives to have medicinal virtues.

That such a condition of affairs in an ant's nest, showing so remarkable a division of labor, must entail a perfect understanding, no one can doubt, and probably these simple creatures have a language as effective as our own.

CHAPTER IX.

ANIMALS AND THEIR YOUNG.

KOALA AND YOUNG.

IN the care of their young, the lower animals exhibit more of what we term intelligence than at any other time; they are then on the alert, and all their faculties are brought into play in keeping up a watchful lookout for their little ones. Many of their actions at this time are undoubtedly instinctive, but others show that the very humblest creatures possess in a greater or less degree that higher power — thought. As we note these acts, not the least interesting feature is their resemblance to those of human beings.

Almost every group has some peculiar way or method of transporting the young; and yet, oftentimes entirely different animals carry their little ones in almost exactly the same way, affording some strange and amusing exhibitions to the fortunate observer, and it is my purpose to contrast some of the more striking of these methods, which show that through all animal life, the various creatures, from man down, are moved by very nearly the same impulses.

One of the most interesting points is to observe how nature always adapts her dependents to their surroundings. Thus in the island of Martinique there are no swamps, yet there are tree-toads; and the very important question arises, "How can the baby tadpoles live?" Almost everywhere else they pass a season of their lives in the water, undergoing certain changes; gradually growing legs until they pass from a fish-like form to that of a lizard, and finally emerge from the water perfect frogs or toads. In this instance nature provides that the little one shall, as soon as hatched, live without water, and we find them clinging to

the mother's back by a glutinous secretion and there carried about with the greatest ease until they jump off and begin life on their own account.

In a larger and remarkable group of animals, represented by the kangaroo, the young when first born are exceedingly minute and absolutely helpless; so tender, in fact, that they would perish immediately if there was not a special provision for them. This we find in the pouch, from which these animals and their allies are called marsupials. The kangaroo, the opossum, the wombat, and a number of others represent them. As soon as the little kangaroo is born it is placed in the pouch, where it remains until quite well grown, and one of the most comical sights is to see a huge kangaroo mother moving along with the little head of the baby reaching out of its resting-place after grass; in fact, feeding as it goes along. The little ones leap from the pouch with the greatest ease, and at the slightest alarm dart back, often diving in just in time as the powerful mother takes a mighty spring and goes bounding away. In former times there was a kangaroo as large as an

elephant, and if it carried its gigantic baby in a pouch, the sight must have been a singular one.

Now, curiously enough, while the kangaroos are the true marsupials, their pouches containing the organs of nutriment, there are many other and widely different animals, which protect their young a horse, and all in all, while the *Hippocampus* al- example is the little sea-horse, which is so famil- iar in collections, and not uncommonly found on the eastern coast. The proper name of the little creature is *Hippocampus*, and it is a fish about four inches in length, although but few would consider it a fish at all. In the first place it stands upright in the water, moving forward by the screw-like vibrations of its back or dorsal fin which is a most beautiful object in motion. The tail ends in a point, without a fin, and is prehensile, or has the power of grasping just as has the tail of some monkeys or the opossum. The head of the little animal is remarkable in its resemblance to that of in a seemingly similar manner. An interesting most heads the list of the fishes it is a singularly unfish-like animal, as we understand the term.

Those that I have found have been on the Florida reef in the Gulf of Mexico, but they live in many seas, and are almost always found clinging to the sea-weed with their little tails tightly wound about a branch, and looking so much like it that only the sharpest eyes can distinguish it; indeed, some species, and particularly one from Australian waters, has long streamers growing from the various parts, giving the animal the appearance of a mass of sea-weed floating in the current.

In the kangaroo it was the mother which had the pouch, but among the sea-horses it is the father upon whom this responsibility devolves, the mother merely depositing the eggs and running away, her maternal duties ending there and then. But as soon as this is accomplished her mate assiduously collects them — just how I think has not been observed — and soon the little marsupium that so resembles the pouch of the true marsupials, becomes greatly distended and packed with the coming brood. It is on the ventral or lower surface, well down and very prominent at this time. The eggs are carried about in this way until they

are hatched, when the sea-horse presses the pouch against some hard substance, and forces the herd of young colts out into the water, and then ensues a remarkable sight which I was once so fortunate as to observe. They seemed to issue in countless numbers, though probably there appeared to be many more than there really were, and all minute pink and white little creatures almost invisible to the naked eye, but the image of their parents and preserving the same curious upright position, moving about slowly through the water, and only to be seen when the sunlight struck the tank in which they were confined. It is needless to say that the parent now loses all control of the herd, and the frisky sea-colts are from this time on at the mercy of every fish that may chance to see them, and in the open water comparatively few of every brood attain a good old age.

In some of the relatives of our common sea-horse, named *Nerophis* and *Protocampus*, there is no pouch, and the mother carries about the eggs attached to the abdomen until they hatch; but in one, called the *Solenostoma* the *mother* actually has

a pouch for the prospective young, formed by the ventral fins, the eggs being attached to or held in place by long filaments which extend from the side.

Among the cat-fishes, which have so many remarkable traits, there are several which possess so-called pouches. In one from Panama, called the Arius, the mother carries her eggs about in a fold of the skin which forms a pouch, until they are hatched.

Among the toads there are many strange methods of caring for the young. In the European obstetrical toad *Ayteles obstetricans*, the male seizes the eggs, which are laid in long strings as are those of our common American salamander, and to make sure that they shall always be in sight heaps them upon his back and winds them about his legs where they remain until hatched. The little toad *Nototrema* of Mexico, has still another method. The eggs are placed upon its back, and finally received in a little pouch or pocket formed by the infolding of the skin. In a Peruvian species the little tadpoles have been seen rolling, wriggling, and scrabbling from the pouch, presenting a

remarkable appearance; but in another species the young pass through all their metamorphoses or changes in the curious pocket, only appearing when they have assumed the adult form.

The *Chiromantis*, a West African frog, exhibits much intelligence in selecting a place for the preservation of its eggs. They are deposited during the dry season, and become hard; but the mother selects a place where she knows there will be a pond or pool in the wet season, and upon some overhanging branch or leaf attaches her eggs in a position where the first rain will soften and wash them into the pool formed below.

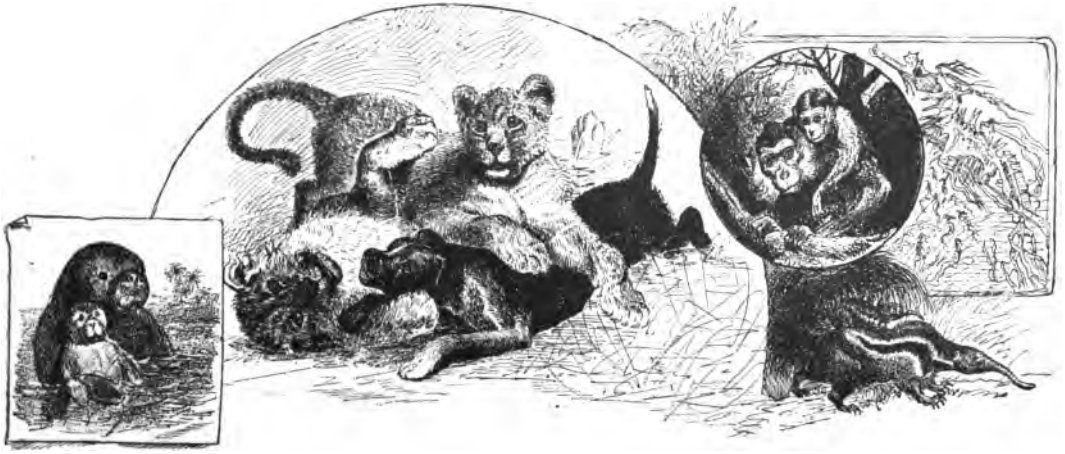
We would hardly expect to find a pouch among birds, yet some of the penguins have one, in which they carry about their single egg; and an albatross has a similar arrangement. The tender care which birds show to their offspring is almost too well known to be dwelt upon, but there are some instances of affection which are of more than ordinary interest. Thus the woodcock has been seen to protect its young in a somewhat remarkable way. A hunter in walking through the brush or

grass, suddenly observed a bird dart up and fly away with something between its claws. Thinking that it was injured he ran ahead and attained a position close enough to see that the mother was bearing between her feet a baby woodcock, perhaps a weak one of the flock which could not escape itself. On another occasion a sportsman saw a woodcock endeavoring to carry its little one on her back; but this was not quite so successful, the fuzzy little fellow rolling off into the grass.

As a rule, birds are very solicitous about building their nests, and watchful of their young until they are able to fly away and care for themselves; but there is one notable exception to this in the Old-World cuckoos, which are either unable or too lazy to build, as when the nesting-time comes the cuckoo hunts out the nest of some other bird and slyly drops in her own egg, which is not noticed by the fond mother, the rightful owner of the nest, until the young are hatched and well grown. In many cases no sooner does the intruder leave its shell than it begins to develop ancestral traits, and boldly tosses out the other occupants, and

obtains all the food for itself. The innocent parent birds are perhaps astonished at their offspring, as it grows and thrives in a remarkable way, and if the nest is small often before the young cuckoo is fully fledged it is larger than its adopted parents who work every hour in the day to satisfy its ravenous and unnatural appetite. In an Australian species, the bird which thought herself the mother, was seen sitting by the side of the nest which was completely filled by a young featherless bird at least a third larger than the poor deceived mother, who must have looked at the enormous mouth of her offspring in wonder and amazement.

In the islands of the Florida Keys I have seen the eggs of gulls so thickly strewn about that it was difficult to walk without stepping upon them. Here the birds were relieved from the necessity of setting, the eggs being left in a mere shallow in the sand where the sun hatched them; and so numerous were the young birds that without doubt they were fed promiscuously by the mothers, though it is possible that each may have recognized her own. Some of these birds, called noddies,



A WATCHFUL LOOKOUT FOR THEIR LITTLE ONES.

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built a rude nest in the trees, and this was often the scene of terrible struggles, as no sooner did the old birds bring a choice morsel in the way of a sardine, mullet, or flying fish to the nest than a score of hermit and other crabs began to ascend the bush and endeavor to steal the food, and not rarely did they succeed; utterly disregarding the vigorous protests of young and old birds.

Among the cat-tribe great solicitude is shown for the young, and the long journeys which cats have made in order to carry their little ones to a place of safety would seem incredible were it not verified by many well-known instances.

Lions and tigers carry their cubs in their mouth just as do our ordinary cats, and this is very generally true of the cat-tribe. A curious instance of rather misplaced affection was seen in the Zoölogical Garden at Central Park some years ago. For a long time an old and large dog, named Fan, had been owned by the Garden. She showed strong attachment for various animals, and finally when a litter of lions was born, and the mother died, it was proposed to make old Fan bring them

up; so her own puppies were surreptitiously removed one night while she was away, and the two diminutive lions put in their place, the only apparent difference between them being in color. When she returned she snuffed at the new-comers but did not seem to notice the change, and from that time assumed entire charge of them. Soon they grew such romping babies that she was unable to oppose them, and they buffeted her about and struck her with their enormous paws until undoubtedly her canine mind was seriously disturbed. Finally they grew so large and powerful that to protect her they were separated. The last time I saw old Fan she was standing looking with amazement at her strange offspring.

A reference to the animals which carry their young in their mouth would not be complete without mentioning the snakes, a number of which, including the rattlesnake, have been seen to receive their young into their mouth in time of danger, and to move off with them. This has often been denied, but the evidence in favor of it is so authentic, and so many persons of reliability

have witnessed the act, that it may be accepted as a fact. Beyond this little affection is exhibited by the mother snake. In some instances when alarmed the mother was heard to utter an audible sound, a hiss which was evidently a call, upon which the young ones darted toward her and disappeared, presumably down her throat, to come out again after the danger had passed. This has been observed in fishes as well, which are generally supposed to have little or no affection for their young. The great studis is said to protect its progeny in this way as well as the Lau Lau, the giant cat fish of South American waters.

Dr. Abbott records an instance he observed which shows that the cat-fish mother was entitled to no little credit for self-sacrifice. The brood was captured and confined in a glass jar on the shore, when the parent actually left the water and crawled upon the bank to reach them, and when they were placed by her side wriggled back again with them. Generally in fishes it is the male which stands by the young, and only in few exceptions does the female exhibit any affection.

The ants, according to some naturalists, rank next to man in point of intelligence, and perhaps this is so, if we judge by their actions, some of which resemble ours. Concerning their young they are very solicitous, and if their house or nest is disturbed, instead of looking out for themselves they seem immediately to think of the young, which are stored away underground, like so many mummies, in some stage of their metamorphosis, and even while covered with earth, amid what is to them an appalling catastrophe, they seize the little white objects, which look like grains of rice, and rush away with them to places of safety. Among the South American ants very ingenious methods are adopted to produce a food which is necessary to the young. This consists of a very small and delicate fungus. These ants may be said to be agriculturists, as they grow this by lining their subterraneous homes with certain leaves, which as they decay encourages the growth of the desired food. The latter is about as large as the head of a pin, and is eaten by the young ants with great avidity. To provide such a supply would

show that these little creatures certainly think; instinct cannot explain it.

The actions of many of the large wasps are quite as remarkable. Some of them dig a tunnel several inches deep into the ground. In the bottom of this, which is both tomb and nursery, are placed the eggs of the wasp, and upon them are dropped spiders and various insects which have been caught by the parent. It might be assumed that these animals would soon decay or dry up, and become useless as food for which they are intended, by the time the eggs are hatched; but the wasp has looked out for this, and instead of killing its captives outright has carefully refrained from injuring them, merely puncturing them with its sting which produces in the victim a state of coma. In other words, the insect is alive, but paralyzed by the sting, and remains in this condition until the eggs of the wasp are hatched, when the young make it their first food. These large wasps are extremely powerful and voracious, and I have seen them dash at a seventeen-year cicada, and even attempt to take it from me when I went to the rescue.

Another example of this care for the young is found in the mole cricket, so common in the South. This little iron-jawed creature erects about its eggs a perfect fortress, surrounded by moats, secret passages and streets, and watches over them with the greatest vigilance. If there is a change in the weather and the cold penetrates the ground the eggs are immediately removed to a nest at a lower level, and after very damp weather they are taken to the surface and given a sun bath so that no fungoid growth can affect them.

Among our Indian tribes we often see the pappoose swung to the mother's back or carried in the way called pick-a-pack, and it is curious to note how many of the lower animals transport their little ones in the same way, oftentimes when it requires no little effort on the part of the parent. One of the most interesting animals I have ever seen was a large South American ant-eater; the long-nosed bushy-tailed fellow that walks upon the side of its feet, so long are its claws, whose scientific name is *Myrmecophaga jubata*. It stood upright, peering at me with its small bead-like eyes,

its great tail completely covering its back like an umbrella, and as I watched the curious creature I became aware of another pair of eyes and another long nose just above the head of the large one, and it soon dawned upon me that the ant-eater had a little one, and that it was perched upon the mother's back, completely concealed by the long bushy tail that was spread over it like a canopy. And this was the way the baby, and sometimes two, was carried about. The great tail serves a double purpose: it not only covers and hides the young when upon the mother's back, but it protects the ant-eater herself, giving her the appearance of a great bush.

While the ant-eater is a slow-going clumsy beast it is an enemy to be dreaded at close quarters; the long sharp claws being terrible weapons. I have been informed that on one occasion a native saw an ant-eater carrying its young pick-a-pack, as I have described, and thinking to secure it for dinner, as the little fellows are considered great delicacies, he approached and attacked it with his spear, when without warning

the animal sprang at him, her babies rolling off as she struck the unfortunate man so powerful a blow with her claws that he was instantly killed. The claws of the ant-eater are its only weapon, being long, sharp, and powerful to enable it to tear open the great ant-hills. Its mouth is extremely small, and at the end of a long pointed snout, while the tongue is of remarkable length and perfectly adapted for the work it has to perform.

In South America another animal, the sloth, carries its young in the same manner; and in the Museum of Natural History, Central Park, there is a specimen mounted in this way, showing the little one upon the mother's back; both looking like some grotesque creature, manufactured out of moss that had been singed or badly damaged in a fire. This uncanny appearance is in itself a protection to the sloth and its young; as when clinging to the branch of a tree they bear an almost exact resemblance to a bunch of moss or some huge fungus.

The brown bear of Asia carries its young pick-a-pack, and when walking along sedately bearing

the cubs, one or two, upon its back, it presents a very curious appearance. In this case it is done merely as a rest for the little one, as when perched upon the mother's back it forms a very prominent object.

In Equatorial Africa hunters often see young animals in curious positions. Once when a party had crept up to a lake in the hopes of finding a herd of elephants, they saw instead some twenty or thirty feet from the shore a large baby hippopotamus that seemed to be actually standing on the water, its huge clumsy feet resting upon it. The hunters supposed that it was on a sand bar, but as it soon began to move away without any motion of the feet it became evident that the thousand-pound baby was upon its mother's back. It rose gradually higher and higher, and as the old one moved up the bank it was seen to be standing on her broad back, being carried up and down stream in this way.

Among our own comparatively familiar animals we find a most interesting example of pick-a-pack riding. The common opossum of the South, the

only pouched animal of this country, first carries its young in a pouch; but when they are well grown and capable of running about, they take their places upon her back and cling there, sometimes six or seven, presenting a very animated appearance; their little black eyes glistening, and the little ears erect. The little opossums have a peculiar way of holding on; in this having an advantage over almost all other animals. Their tails are what is called prehensile, or have the faculty of clinging to any object like the tail of the so-called ring-tailed monkey; so when they leap upon the mother's back they clasp their tail about hers and so retain their hold; the mother bending her tail over her back so that all may have a secure grasp, and in this way the family travels about among the tree tops in search of food.

Nearly all the monkeys carry their young in their arms, and they are often seen astride of the neck, peering over the mother's shoulder in a comical way.

The whale will often support her young on her back, and I remember an instance where a Cal-

fornia whale and calf were followed in shore; the latter wounded by the whalers, was floundering about and sinking, ultimately to be drowned, when the devoted mother rushed to the rescue, and placing herself under the enormous baby lifted it up near the surface so that it rested upon her back, and actually endeavored to carry it off in this position, falling a victim to the bomb of the whalers while attempting the rescue.

The sea otter, that is found in the same waters, is also noted for the care of its young; the little ones being carried about in every conceivable position. They are often found in the great kelp beds that lie between the breakers and the shore in some parts of the Pacific coast. The gigantic weed breaks the force of the waves, and forms a partial resting-place. Here the otters are often seen lying upon their backs or swimming about, bearing their little ones, and sometimes tossing them into the air just as human mothers toss their babies to hear their shouts of merriment.

The dugong with its grotesque, almost human face, supports its young upon its flippers, and this

occurrence is probably the origin of many of the tales of mermaids which so many of the ancient works contain. The old voyagers, seeing the curious figure half out of water, holding the young in so human a position, readily believed it to be the mermaid of which they had heard.

There is hardly a branch of the animal kingdom in which we cannot find some creature whose little ones ride pick-a-pack. The young scorpions as soon as born crawl upon their mother, covering her with a bristling array of claws and tails, so that she is often completely hidden, and, terrible to relate, they soon devour her for her pains.

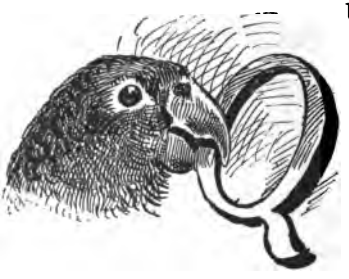
Many spiders ride about upon their parent's back, and when they are disposed to stray away first fasten a thread of silk to her, as a sort of apron string by which they can travel back. The mother spiders are particularly careful of their young, and when bearing the egg sac about are very courageous. I have taken hold of an egg bag held by a mother, and had her dart at my hand, pull and struggle, and only release her hold when she was actually forced away. To protect their nests some

species adopt the most remarkable expedients. Some make burrows in the ground which are closed by spring doors covered by growing plants placed there it is alleged by the spiders themselves. Once in these silk-lined dens the enemy might expect to find the young spider family, but, branching off from the main tunnel, another will be found also having a door, which closes so perfectly that only the sharpest-eyed enemy can perceive it, and here perhaps the young spiders lie concealed, feeding on the results of their parents' foraging.

Other spiders envelop their eggs in a silken balloon, and suspend it by a single thread, and thus floating in the air it is safe from attack, not only moving about at the mercy of the breeze, but resembling a delicate plant, and so finding protection.

CHAPTER X.

HOW ANIMALS TALK.



A TALKING BIRD.

QUITE recently an attempt has been made by an eminent scientist in England to teach a dog to talk, and the methods employed were extremely interesting. Blocks of different colors were identified with certain objects, and in this way it was hoped the pupil could be educated above the average of its kind.

It is incorrect to say "this dog or monkey can be *taught to speak;*" as these animals already have a language of their own, and speak it, and human attempts at their education merely result in

teaching the pupils a new language or method of expression.

Such efforts at animal education can be made by any one, and it is often astonishing what advancement the humblest of the learners will make. Object-lessons are best adapted to their faculties, and if success does not always follow it must be remembered that the lower animals vary as to their intelligence just as do human learners; there are the dunces, the lazy ones, and the phenomenal students.

In the selection of animals to be trained, only a few comparatively, will be found possessing the requisite traits, and here, too, intelligence is not always the result of breeding. Indeed, it is more apt to appear in mongrel dogs than in the five and ten-thousand-dollar-prize animals of the exhibition. I refer here to the teachable intelligence; and in companies or troups of trained dogs those that develop the greatest proficiency are generally dogs whose pedigree is a labyrinth difficult to trace.

In teaching an animal our language we would first endeavor to show that certain objects meant

certain things. Thus if we have a block of a green color with the word "water" painted upon it in yellow letters, and made the dog bring this every time he was thirsty, it would appear that he understood the meaning of the word. But I have my doubts as to this, and believe that the dog associates the highly-colored block with water just as the horse or cow associates the pump with the same; so that while many animals appear to understand certain words, I think they do so only in a general way, and that it is often the inflection or modulation of the voice that has the desired effect.

We must not, however, judge the lower animals harshly simply because we cannot teach them to understand our language thoroughly, as they have their own means of communication as complete and perfectly adapted to their needs as language is to ours.

The lower animals have several different methods of communicating their wants. We will consider first, vocal communication; second, sound signals not vocal; third, talking by touch; fourth, by light and odor; fifth, by signs.

The first method is common among nearly all animals; the whales — though some authorities insist that the whale has a voice — and the majority of fishes being the exceptions. Among birds especially, the vocal speech is understood and admired.

As an example of bird-language, the ordinary domestic fowl presents the most interesting and perfect range, so common that it is rarely appreciated or reflected upon; not a few will be astonished at the vocal possibilities of the hen if they will give the subject a little investigation.

Knowing that the hen has a voice, we assume that its office is to afford communication between individuals. Half an hour in a farmyard will beyond question demonstrate this, and that certain sounds are the equivalents of words. The crow of the cock is assuredly a challenge, the moment another bird is noticed, and is kept up either in advance or retreat. It is sounded in the morning in answer to others, and is comparable to the challenge or war cry of many savage tribes, or even the answering shouts of college boys or men, that

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are unexplainable on other grounds than a challenge of merits.

Observing closely our rooster, accompanied by his family, we notice that the hens pay no attention to the challenge; but let him find some delicacy, he utters a succession of short notes, "Tuck, tuck, tuck, tuck!" upon which the others rush about him eager to share. Again, if a hawk flies overhead, the cock, guardian of the flock, raises his head and utters a prolonged note, as different from the former as possible; "Ka-r-r-r-e," he seems to say, which translated into English means "look out for the hawk! run!" and immediately hens and chickens duck their heads and rush for cover. Now let a dog dart after the head of this family, and listen to the clucks and other sounds coming fast and furious — protests in every intonation.

The hen cannot crow, but she has in other respects as perfect control of language as her master. Indeed, she can sing; purely a self-congratulatory performance expressive of deep contentment and complete satisfaction, heard when hens are let out and they are running for food, and upon warm days

in spring it is a "kerr, kerr, kerr," differing in its modulation and intonation in individuals. How different is this from the sharp "cluck, cluck" of the mother-hen. The latter is a general warning to everybody, and plainly says, "I have a young family, and must be let alone." If a grain is found how suddenly this is changed to the quick call, "Tuck, tuck, tuck!" upon hearing which the little ones come rushing pell-mell; and they understand it the moment they leave the shell. Indeed the different notes, or "baby talk," of a hen are of great variety. No one would think of saying that the "cut, cut, ca-da-cut" was a call. It says as plain as words can tell, "I have laid an egg," and the bright little egg-hunter who hears immediately starts for the hay loft, as a favorite hound of mine was in a habit of doing. She understood hen language, and fed upon freshly-laid eggs for some time before I discovered that she was such a linguist. The moment "cut, cut, ca-*da*-cut" was heard she trotted to the hen coop.

When the little chicks are nestled under the mother another sound is heard, a prolonged hoarse

"c-r-a-w-z-z-e, c-r-a-w-z-z-e," which I copy from a happy mother in my possession without the aid of a phonograph. Enter a chicken-coop at night, and a soft whistling noise is made, a gentle chirping by the birds, sounding something like "w-h-o-o-i-e," rapidly repeated, that speaks plainly of apprehension. If a chicken is seized by the leg the "c-r-a-i-a-i-o-u, c-r-a-i-a-i-o-u" that follows could never be construed into anything but a wail of anguish. So if we commence a dictionary of the domestic fowl-language we might have the following as a basis:

Ur-ka-do-dle-do-o-o. Challenge of male.
Tuck, tuck, tuck. Food call of male.
K-a-r-r-e. Announcing presence of hawk.
Cut, cut, ca-da-cut. Announcement of egg laying.
Cluck, cluck, cluck. Call of young.
Kerr, kerr, kerr. Song of contentment of hen.
C-r-a-w-z-z-e. Quieting young chicks.
W-h-o-o-i-e (whistle). Expression of apprehension at night.
C-r-a-i-a-i-o-u. Terror and protest at capture.

These sounds of course vary in individuals; that is, in the intonation, as, like persons, no two birds can utter the same vocal sounds.

This can be applied to other birds, and those who have listened to the notes of a robin in its attempts to teach its young to fly, and many other birds, well know something of the range of their vocal resources. Birds differ in this respect. The notes of the owl are a mournful hooting, accompanied by a hiss as a protest. A brown pelican which I kept as a pet, was limited to an asthmatic wheeze. The so-called language of parrots, mino birds, ravens, and bullfinches is merely the expression of an imitative faculty wonderfully developed; their sayings appearing to result from intelligent thought simply because they are often uttered by accident at an appropriate time; but it is needless to say that the birds do not understand what they are uttering, and repeat the sounds, just as a carriage dog places himself between the wheels from habit.

Among the higher animals, as the mammals, we find a wide range of "words," as we will call the sounds uttered. Between the howl of a stray or lonesome dog and its gladsome bark upon meeting its master, there is the greatest possible difference.

The musical baying of the hound, the howl of pain, the whining and whimpering, the bark at a foe are all totally different expressions of as various emotions.

A little dog owned by me for a number of years always seemed to have a command of language, and to understand English. When thirsty he would give a sharp bark oft repeated, run a few steps toward the water faucet, and look at it, then at me, repeating the act several times. If I persisted in misunderstanding him, as I often did, he would seize my sleeve in his mouth and endeavor to lead me to the water; as much as to say, "if you can't understand plain dog-talk I will try and show you." This little dog was educated by a German, and when we first obtained him, evidently did not understand English, though he quickly learned. Every morning the servant who took in the mail would give it to him and tell him to carry it upstairs, which he would always do. Sometimes he would find the door closed, when the girl would call out "tell them to let you in," upon which he would bark, and if told, "they don't hear you;

speak louder," he would utter a louder bark, and come dancing into the room with every evidence of delight and importance.

Some dogs talk by signs only, and all dogs and many animals express their emotions by certain movements not to be mistaken. Thus a dog expresses rage by its lowering appearance. The hair upon its back stands erect, the tail is moved in a suggestive manner, while the lip is lifted over the canine teeth, an act similar to the human sneer in which the same tooth is exposed. Joy, on the other hand, is evinced by an excessive wagging of the tail, many dogs lifting the lips and showing all the teeth, or laughing, the entire body undergoing a screw-like movement.

In a cat the actions are equally suggestive. Joy is expressed by purring, and rubbing the body affectionately against one, the tail being elevated. The appearance of a dog will produce an instantaneous change. The ears fall back, the tail seems to assume twice its natural size, the back is elevated, and all the signs are fighting-signals not to be mistaken by man or beast.

The elephant, one of the most seemingly taciturn of animals, has several ways of expressing its wants and desires, though these sounds have a different meaning imputed to them in India and Ceylon. The shrill cry uttered through the nose or trunk is indicative of rage. Warning is given by one elephant to another by a sound uttered by the lips resembling the word "prut," or the twittering of a bird; and wild elephants have been heard to make a sound resembling that produced by a cooper in hammering a cask.

Elephants often express their pleasure by a squeaking noise, though I have heard the same when they were prodded by the keeper. These animals often purr gently to express their pleasure or satisfaction, the sound being audible to the driver only. Rage is commonly expressed by a hoarse rumbling in the throat, and fear by a reverberating roar; suspicion is conveyed to others by rapping the trunk upon the ground, producing a sound resembling that of tin being doubled up, which is an example of a sound-signal, not produced by the voice.

Reptiles are particularly deficient in vocal sounds. Among crocodiles and alligators the males roar like bulls, and both sexes hiss; but simple as the latter is I am confident that by its intonation it is expressive of different emotions; yet so alike are the utterances in tone that they are perhaps not distinguishable by man.

That the hiss of the snake is a means of communication there can be no doubt. This is well shown in the following letter written me by Colonel Nicholas Pike, late consul to Mauritius, which demonstrates that the mother-snake unquestionably calls her little ones to her. As the letter contains some new and valuable testimony regarding the protection of young snakes, I give it entire:

DEAR MR. HOLDER:

There has been a controversy for years among naturalists relative to the question do snakes swallow their young, and there are many professors of Herpetology at the present day who ridicule the idea. I have been cognizant of the fact for over fifty years. When a boy I began my studies in Herpetology, and was not satisfied with knowing the names of our reptiles, but sought them in the fields, swamps, and forests. I learned much of their habits, and from time to

time kept them in confinement, and have reared many. Prof. C. Brown Goode, of the Smithsonian Institute, read a very interesting paper on the subject before the Amer. Inst., for the advancement of Science at Portland, Me., Aug. '73, which ought to have settled the question.

The first time this came under my notice was in July, 1830. I was roaming over the fields when I saw a good-sized garter-snake (*Eutaenia sirtalis*) very near me with numerous young ones around her. As I approached her she placed her head flat on the ground, opening her mouth and making a *peculiar noise* the little ones evidently understood, for they all ran into her œsophagus. I picked her up by the neck and put her in a bag, and took her home. On examination I found I had about twenty snakes including the mother. They were kept together in a box, and when I told the story to my friends they ridiculed me. It was not long, however, before every person in the house was convinced of the truth of my assertions, from witnessing the fact themselves.

I met with a curious incident some years ago. While hunting snakes in the swamp at Melrose, I came across a male and female striped snake with numerous young ones. The parents were near each other, the family crawling over and around them. I was going for them, when on second thought I concluded to watch them. They did not appear frightened, but went on gamboling about for some time. I went a little nearer when both snakes turned toward me, making a *faint noise*, placed their heads flat on the ground and received the young as stated before. It was a curious sight to see these young snakes not long born, some of them a foot or two away, turn at the noise and instantly seek

refuge. I am certain it was a note of warning of danger. I caught both snakes and put them in separate bags. The female had ten young and the male had swallowed five. This is the first instance of any notice of a male snake performing this affectionate duty for its young. I placed the whole family in a box where they lived peaceably a long time.

Mr. Julian Hooper and myself encountered a large water snake (*G. sipedon*) on the banks of a small pond in Durham swamp. I was about to capture her when we saw a number of young entering her mouth, and before I could strike her she entered the pond. I immediately swept the pond with my net, and in two or three minutes captured her, but on examination could find no young. She had evidently in that short space of time deposited them under some tussock in the bank out of harm's way. What instinct for the preservation of her young!

I have also seen the *Eutaenia saurita*, *Heterodon, platyrhinos*, and the *Crotalus horrida* perform this act for their young. Some rattlesnakes kept in confinement frequently did the same with their progeny when frightened. The beating of a drum near the case seemed to terrify the old ones so that at the first tap they would secrete the young in the œsophagus, and vibrate their tails furiously, and they would not release the little ones till the noise ceased. I could relate numerous instances I have seen where different species of snakes have thus protected their young. I was assured by a Portuguese naturalist in Rio that he had seen a number of the water snakes swallow their young, also a boa constrictor.

Jan. 4, '87. NICHOLAS PIKE.

Among the insects we find examples of a language produced by sounds not vocal. The grasshoppers, locusts, and crickets are familiar forms among the noisy insects. In the first named, *Acrydii*, the most deafening sound is produced not from the mouth, as one might suppose, but by rubbing the thighs against the fore-wings, so that it is really the result of fiddling. If the leg of a grasshopper is examined with a microscope the ridge of fine teeth that produce the rasping sound, will be seen.

Among the locusts, whose singing is often heard above everything else, the base of the anterior wing is transparent, forming a drum with which the males utter shrill calls; the sounds in different species differing, and also it is said between day and night.

The familiar katydid utters the curious notes for which it is named, by rubbing the inner surface of the hind legs against the outer surface of the front wings. The shrill cry of the male cricket is made by elevating the fore-wings and rubbing them against the hind ones.

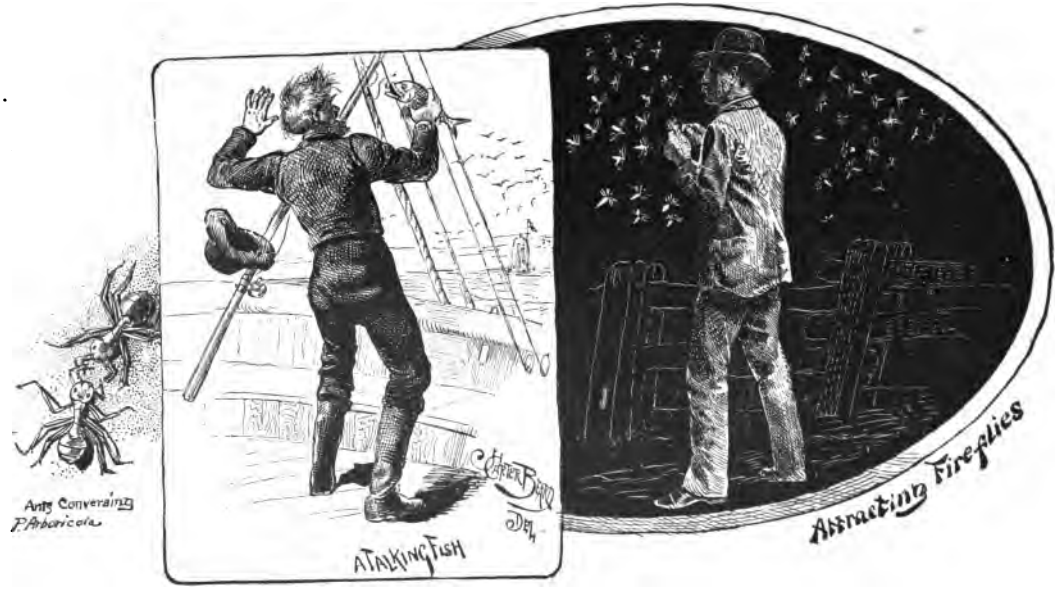
The penetrating call of the cicada is produced by a drum-like organ at the base of the abdomen. So here we have a veritable band of musicians, fiddlers and drummers, whose notes constitute their simple language. Many beetles and some butterflies produce a clicking sound.

That ants and various insects have a means of communication few can doubt who watch them attentively. Some ants when meeting are seen to touch each other with their antennæ, and in a former chapter we have seen that a blind beetle seemed to request food by tapping an ant. Mr. Forel, a French naturalist, records some very interesting instances of undoubted communication between ants, and Sir. John Lubbock demonstrated to his satisfaction that ants had some means of communication by a series of interesting experiments. For example, a fly was presented to an ant and pinned down. The ant after tugging at it for half an hour went to the nest and immediately came out with five or six companions. This experiment always resulted in the same way, a certain number of ants appearing evidently in answer

to the request of the discoverer of the food supply.

Whether fishes have a vocal communication is difficult to determine. That they hear is well known, and nearly one hundred species have been heard to utter audible sounds out of water, this probably representing a very small proportion of the finny sound makers. How far such sounds can be heard with water as a medium it is impossible to say, but I have often gone beneath the surface with another swimmer to determine the distance that sound could be heard, and the clinking of rocks was audible many feet, so it would appear that there is nothing to prevent the transmission of sound waves.

During an extended stay in the tropics I had many opportunities for observing the habits and ways of unfamiliar fishes, and I shall never forget my first experience with one of these "talkers." I was fishing in the channel, and hauled in a little fish about six inches long, of grey iridescent hues and a very large mouth. The moment I unhooked it, still holding it in my hand, it gave vent to the


Ants Conversing
P. Arboricola
A Talking Fish
Attracting Fireflies

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most remarkable series of grunts and groans I had ever listened to. I tossed it into the boat, upon which its appeals, for so they seemed, were redoubled, and that they were not ineffectual is shown by the fact that I quickly returned the supplicant to its native element. That these sounds were expressive of pain and terror I have not the slightest doubt. The name of this talker is Hæmulon, its common one "the grunt." It represents a large family, many of which utter vigorous protests when caught. I have heard the dog-fish, a small shark, common on our Eastern coast, utter a loud croak, easily construed into a bark. The little porcupine fish, the cow-fish, a great porgy, and the grouper, common on the outer Florida reef, have all talked to me as I unhooked them.

The sounds made by fishes are produced in different ways, and many are undoubtedly involuntary. Some are due to the action of the pneumatic duct and swimming bladder while others are produced by the lips or the pharyngeal or intermaxillary bones. Under this head come the sounds uttered by the carp, tench, and others. The fishes

of the genus Trigla and Zeus utter a low murmuring sound, probably produced from the swimming bladder which has a diaphragm and muscles for opening and closing it.

The loudest sounds are made by the drum-fish, *Pogonias chromis*, and off the New Jersey shores remarkable noises have been heard, accredited to them. Some observers say that the sound is produced by the fishes striking their tails against the vessel's bottom; others again consider it due to the clapping together of the teeth.

The noises made by cat-fishes and eels are produced by forcing air from the swimming bladder into the œsophagus, and, according to Dr. C. C. Abbott, the latter produce a more distinctly musical sound than any others observed by him. The note, a single one, frequently repeated has a slightly metallic resonance.

Some of my young readers may think that because the sounds are uttered from the air bladder they may have no meaning; but it should be remembered that the air-bladder of fishes is homologous to the lungs of the higher backboned ani-

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mals, and the pneumatic duct referred to as a producer of sounds is to be compared, as regards its function, with the trachea of birds and milk-givers.

The curious little sea-horse, remarkable for its method of protecting its eggs, utters low sounds, supposed to be due to the vibrations of certain small voluntary muscles. The mud sunfish is said to make a grunting sound, and I have heard the low growl-like croak of the chub or *Semotilus* on the St. Lawrence. The gizzard shad, *Dorosoma cepedianum*, utters a whirring sound, the chub-sucker, *Erimyzon oblongum*, a single note, followed by a discharge of air bubbles, while the cat-fish, *Amiurus lynx*, makes a gentle humming sound.

An English officer, Lieutenant White, has placed on record a wonderful instance where in the China Sea the sounds that came up from the deep were so loud and piercing, so strange and uncanny as to alarm the superstitious seamen. They were described as resembling the clanging of bells, the twanging of a gigantic harp, and the escaping of steam. The notes were continuous for some hours,

and were attributed to a school of unknown fishes in the vicinity.

The cuckoo gurnard is said to utter a grunting sound, and I have heard the bark or grunt of one of our common gurnards at a distance of twenty feet.

Aristotle and Ælian both refer to the sound-emitting fishes of the Mediterranean. The Ceylonese fishermen are familiar with a fish, found in the lake of Colombo, which they call magoora, which makes an audible grunt when disturbed, and Pallegoix in his history of Siam refers to a brilliant fish resembling our flounder, that the natives call the "dog's tongue," which attaches itself to the bottom of a boat and gives out a melody of sounds, though it might appear the contrary to us.

Some years ago considerable excitement was occasioned at Batticaloa, Ceylon, by the report that musical sounds were heard rising from the sea in various places. Sir. E. Tennent visited the locality, and interrogated several fishermen who had heard the noises and described them as resembling the

faint sweet notes of an Æolian harp. According to the men the sounds were only audible during the dry season, and they had always known of them, and their fathers before them. They stated that it was not a fish that sang, but a shell or mollusk which they called in the Tamil tongue the *oorie cooleeroo cradoo*, or crying shell; the name evidently being an attempt to reproduce the sound. The men soon pointed out some of the musicians which proved to be the shells known to science as *Littorina læris* and *Cerithium palustre*. Sir. E. Tennent employed the men to take him to the place, and one moonlight night they rowed him to a spot about two hundred yards northeast of the jetty by the fort gate. When the boat rested in perfect silence, not a breath of wind blowing, he distinctly heard the musical notes. "They came up from the water," he says, "like the gentle thrills of a musical chord or the faint vibrations of a wine-glass when its rim is rubbed by a moistened finger. It was not one sustained note, but a multitude of tiny sounds, each clear and distinct in itself; the sweetest treble mingled with the lowest

bass. On applying the ear to the woodwork of the boat, the vibration was greatly increased in volume. The sounds varied considerably at different points as we moved across the lake, as if the numbers of the animals from which they proceeded were greatest in particular spots, and occasionally we rowed out of hearing of them altogether until on returning to the original locality the sounds were at once renewed."

Such sounds have been recorded from several localities in India. A party was once passing from the promontory Salsette to near Sewree in the harbor of Bombay when they were astonished to hear sounds like the protracted booming of a bell, the notes of an Æolian harp, or a pitch pipe, or any long-drawn musical note. They at first thought it music from the shore, but it was soon found to come from all about, and the boatmen said that it was caused by numbers of fishes that were found there. By placing the ear against the rail of the boat the sounds were heard with great distinctness.

Similar occurrences have been reported from

the waters at Caldera, Chili, and at the mouth of the Pascagonla creek, Miss.

While the information concerning sound-producing mollusks is very meagre, some investigations have been made. Dr. Grant experimented upon the *Tritonia arborescens* and found it produced a sound under water like "clink;" as if a piece of steel wire was struck against the glass at short intervals. Dr. Grant made his experiments in the presence of the members of the Wernerian Natural History Society of Edinburgh, and the listeners around the table distinctly heard the "clink-clink" of the little Tritonia at a distance of twelve feet, and the combined efforts of hundreds, perhaps thousands, might easily produce a loud volume of musical sounds. I have heard a similar noise proceed from the great conch, *Strombus gigas*, also a clinking; and undoubtedly investigation would show that numbers of marine animals are capable of uttering sounds that have their meaning in the economy of nature.

The fact that innumerable animals are possessed with light-emitting organs suggests the

belief that the consequent flashes and gleams of light often under control of the animal, constitute a sign language. In the case of a fire-fly it has been proven that is used as a signal or call, a gentleman holding one up so that its light was visible, immediately its companions approached it.

In almost every branch of the animal kingdom we find these marvelous light-bearers: fishes, insects, echinoderms, mollusks, worms, medusæ, corals, infusorians, crustaceans, all have their lights, varying greatly in color and intensity.

One fish, *Malacosteus niger*, has two gleaming lights upon its head, yellow and green respectively. The Appendicularia, a little degenerate vertebrate, emits three distinct colors; the crustaceans glow with blue tints, and that this wondrous phenomenon has its meaning and use we cannot doubt. It is the sign-language of the lower animals, warning or attracting as the case may be.

CHAPTER XI.

THE SPORTS AND GAMES OF ANIMALS.

Malayan Sun-bear playing with a ball

TO those who have cared to watch the actions of the various animal forms which frequent woodland and stream it is evident that they not only have a sense of something akin to humor, but have games and sports with which to pass the time away.

Naturally this is more noticeable among young animals. Particularly sportive are the fishes, though this is not generally known from the diffi-

culty in making observations, as these odd playfellows will not indulge in their pranks if aware of being watched.

One of the most fascinating pastimes that I ever engaged in was to play the spy upon a submarine fish-village; and many a curious performance did I witness. My point of observation was an old wharf not many miles from the city of Havana. It was built out into the Gulf Stream, but long ago had fallen before the teredo, and its piles had crumbled until it rested just above the water like a hugh raft ready to be launched.

In this warm country shade was acceptable to even shore-loving fishes, and beneath the protecting shadow of the old dock large numbers of what I soon began to term "my finny friends" would congregate. The planks were everywhere pierced with auger holes to let off water in the days when the wharf was in use, and by lying flat and applying my eyes to these port-holes I looked down upon the neighborhood unobserved. The shore here was a pure silvery sand, quite sloping, so that it afforded an extended field for observation; the

inshore portion of about twelve feet being the resort of small fishes, while from there to the channel large forms made their headquarters.

Almost the first impression received from watching these fishes was that they were domestic; in other words, they had a home-life. As soon as I learned to distinguish certain ones I found them day after day about the same stumps or posts, never venturing far away. The fishes which made up this suburban settlement, seemed to be of infinite variety; but perhaps altogether there were twenty or thirty different kinds, including the stragglers which came in from time to time, perhaps on a visit, from an old wreck that was another favorite spot not one hundred feet distant. There were angel-fishes in gorgeous garbs of yellow, blue, and black; snappers of rich brown hues, and their cousins, the grunts; some striped black-and-white, others mottled with old gold and vermilion, all together a very brilliant assemblage. Then there were minute fishes resembling a sapphire in color, actually scintillating as they darted about, while cow-fish with veritable horns, doctor-fish with lan-

cet ready, an occasional remora with its curious sucking disk, the lithe barracuda, the spiny porcupine, and many more.

There always appeared to be the best understanding between these villagers, if I except the barracuda and the doctor-fish. The former was apt, when no one was looking, to move silently and slowly in shore, and pick up and devour an infant fish; while the doctor had a habit of trying to lance any one that came too close. But among so many there were not very disturbing elements, and to the little fishes especially every day was a holiday, and to eat and enjoy themselves was the one object in life.

A game of tag was perhaps the commonest performance. One little fish would dart at another, and then be joined by several others, until finally a dozen or more would be seen following the leader, who darted around the piles and posts, finally joining the throng to in turn chase some other fish which seemed now to be selected as "It." Sometimes "It" was caught; but there never was the slightest roughness to show that any-

thing but pleasantry was the object, and when a playfellow was "tagged" that ended it; the game either being stopped or the chase transferred to another fish. I rarely visited the fish village but such a game was going on.

Very often in midday, when the sun was beating down fiercely, a large school of sardines, little fishes allied to the herring, would take shelter beneath the old dock. Packed side by side, thousands upon thousands would lie with their heads in one direction, all taking a midday siesta, as the naps of fishes go. So large were these schools that they sometimes entirely filled the space beneath the platform and hid the real residents from view. As they, too, were young fishes, it is not strange that they should indulge in games, and, like the others, they had their games of "tag" and "chase," often hundreds joining in the sport.

But the pastime most affected by these silvery creatures was that of jumping; this seemed to be entered into with the greatest enjoyment and spirit. The leaping was of course not done under water, but as follows: as the tide rose the sticks and

twigs that had been stranded were floated off, and soon drifted out to the school. As soon as a stick was observed by the argus-eyed throng, a score or more would dart at it, and with a frisk of their tails, a splash and clatter, over they would go, out of the water, clearing the float with all ease imaginable. Others would follow, and I noticed that those who once performed the feat returned again and again; showing that it was a matter of decided enjoyment. Sometimes when a supply of sticks was on hand a dozen of these games would be going on at one time.

I frequently observed the fishes taking curious positions in the water without apparent purpose. Some would poise with head down, allowing themselves to gradually float upward until the tail touched the surface, then dart off with great velocity, just as if they had been "playing 'possum." Others would swim round and round in a circle, or take a number of short leaps out of the water, making a hop-skip-and-jump movement. Personal contests, seemingly in play, were often carried on. One fish would seize another by the side fin, and

the two would swim about and struggle for some time, until, perhaps, another fish would interfere.

Such performances as leaping out of water are not confined to small fishes. I have seen large rays do this, coming down with a crash that could be heard for a mile. The breeching, as it is called, of the whale, though not a fish, probably comes under the head of playfulness, and their mighty gambols are common sights to whalers.

While it is extremely difficult to train fishes, I have made them participate in what might be termed a game, and the sport can be carried out indefinitely. The fishes which I experimented with were a common Northern sunfish and a tri-tailed Japanese fish. I bought the former because it had a reputation for pugnacity; its owner averring that it killed all fishes placed in the tank with it. I thought this a mistake; but after losing several triple-tailed Japanese fishes I found that my sunfish was a veritable bully and was determined to have a tank by itself; so I accordingly divided off the aquarium by a glass partition, and put the tyrant in close confinement. Being a courageous

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fish it did not require much instruction or training, and soon not only fed from my hand, but would leap some distance out of the water for flies and other articles of food, and finally came to expect its supply, darting to the surface the moment I approached the tank. This familiarity was the occasion one day of a laughable accident to a pet kitten. Feeling thirsty she sprang upon the top of the aquarium, and balancing herself upon the edge began to drink. But the moment her red tongue touched the water the sunfish saw it, and darted to the surface, and the next second had the tongue firmly in its mouth. It is difficult to tell which was the most surprised. The kitten gave a howl, lost her balance and fell into the tank, from which after floundering about a moment she escaped, and with a wail of terror darted from the room, leaving the fish, that had found out its mistake, rushing about with fins erect equally demoralized.

This, however, did not deter the sunfish from darting at everything; and this readiness to bite all objects suggested that fish-power might be ex-

perimented with; so a mimic belfry was arranged over the aquarium and the bell-rope allowed to hang over the water. This can be done by any one, and if to the string a bit of meat be attached, the fish will seize it, and in its attempts to detach it will ring the bell. By finally replacing the meat with a colored pebble the fish can be taught to ring for its own dinner, and if it be one of the curious tri-lobed gold-fish found in almost any collection, the performance is a very attractive one.

These entertainments can be extended indefinitely. Small cannon can be fired by having the fish pull the lanyard, windmills can be worked, music-boxes wound up, mimic engines started; in fact many devices invented for the edification of young people. A miniature mermaid can be floated upon the water, or a marine jumping-jack, and the fish will pull the string that is dangling below, giving the figures an extremely life-like appearance.

That insects have their games and sports I am convinced. This first occurred to me while in the Adirondacks some years ago. I was some dis-

tance in the wilderness, and having found a small clearing was resting from my climb, when suddenly the sun, that had been obscured, sent a band of light through an opening in the trees and at once transformed the spot into a veritable fairyland. From all about innumerable forms of insect life seemed to spring into the gladsome light, and soon the great sunbeam was the scene of such revelry as is only imagined by tellers of fairy-stories. A band of gnats, or insects resembling them, seemed to be performing some mystic dance. They floated on the beams of light; rising and falling in undulating lines, forming and re-forming, now disappearing, as if at some preconcerted signal, only to appear again in some new shape. So regular and exact were these movements that I was impressed that they had some meaning. In and about this band of players various other forms were darting. Such games of tag! such aerial leaps, dives and plunges! all showing that this sunbath was being enjoyed to the utmost extent.

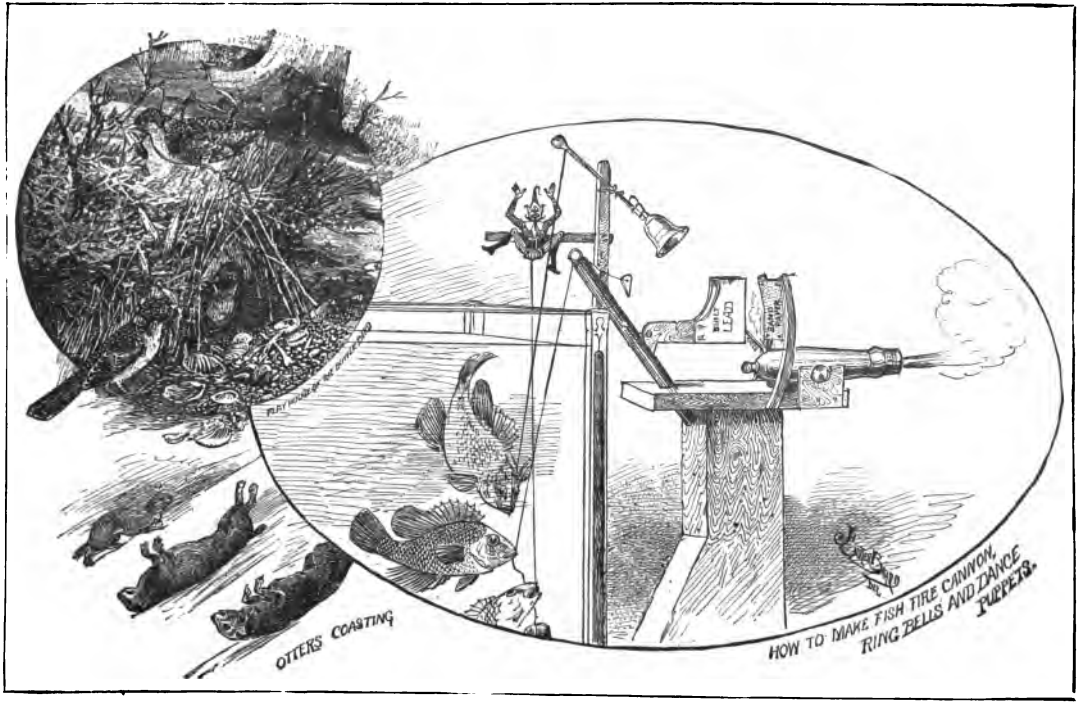
Once while lying on the rocks that face the ocean not far from Nahant, I was attracted by a

curious clicking sound, first on one side, then on the other; as if a system of signaling was going on. Recognizing the note of one of the locust tribe, I carefully turned and saw half a dozen large rusty-brown fellows, commonly known as grasshoppers, which so exactly imitated the rocks in color that it was with the greatest difficulty I distinguished them when not in motion. It was apparent that they were engaged in some curious performance, as they were marching about in the most erratic manner, dodging and hiding behind pieces of stone, and exhibiting remarkable acuteness in avoiding each other. All the little irregularities of the rocks were carefully taken advantage of, and their motions in creeping upon one another reminded me of those of a cat, so stealthy and sly were they. This game of hide-and-seek was occasionally varied by a leaping performance. Two locusts would gravely face each other, and then as if at a given signal they would jump into the air, one passing over the other in the flight, alighting and assuming the same positions only reversed. I watched their manœuvres for some time, and lis-

tened to the curious clicking that accompanied them; but finally an incautious movement broke up the games, and the players flew away, seemingly uttering vigorous protests.

The love of sport is not confined to these lowly creatures. I doubt if an animal can be found which does not in some way or at some time show a desire for what we term "amusement." Among the land animals, or rather the land and water animals, the otters are especially noticeable from the fact that some of their games are exactly like those of human device. It was Audabon who first chronicled their actions, he having watched them from a secluded spot, and since then their games have been enjoyed by many observers. The otters (*Lutra Canadensis*) are perhaps the originators of the games of sliding down hill and tobogganing.

Otters are always found about streams; building their tunnel-nests in the banks, having, as a rule, one entrance into the water, and another on shore. During the winter a bank is selected having a good incline and leading into the water or sometimes out upon the ice. The snow is then carefully



ANIMALS AT PLAY.

patted down and rendered as smooth as possible, and finally becomes a glare of ice. This accomplished, the others start at the top of the hill, and turning upon their backs give themselves a push with their hind feet, and away go the living sleds, dashing down the incline, turning at the bottom and with a splash entering the cold water, or darting away on the smooth ice. So fond are the animals of this sport, they keep it up for a long time, and hunters watch the slides, knowing that here they have the best chance of finding the otters.

The sea-otters are just as playful. They are found lying on the great kelp-beds off shore, and have been seen tossing their young into the air, riding on the breakers upon their backs, and going through a number of motions of an extremely interesting nature. That these occurrences are truly games, one needs but to watch the domestic cat and her kittens; and young lions, tigers, and all the cat tribe have similar dispositions, while if we turn to the monkey its entire existence is seen to be a continuous game, or an endless series of practical jokes perpetrated upon its fellows.

The Malayan sun bear is remarkable for its fun-loving nature. A ball of wood will serve to entertain one of these little creatures, and enable it to perform the most grotesque and curious antics. The common black bear is almost equally playful; and its rough-and-tumble games in a treetop are some of the most interesting performances I have over witnessed.

Even crabs appear to have a sense of humor, and to go through certain manœuvres presumably games. I remember once in Florida in crossing a long marsh to have come suddenly to a spot not covered with grass, where an immense number of crabs, known as fiddlers (from the fact that one claw is of enormous size, comparatively), were marching about in what appeared to be regular order. There must have been several hundred, and with the great claws held aloft they were wheeling, backing, marching and counter-marching; making no attack upon each other, but moving about in a solemn array that undoubtedly gave some satisfaction to the participants.

Among birds we find many instances of this love

of sport. Quite recently a European naturalist made an extensive trip through Peru, paying special attention to birds, and one day while sitting beneath a low tree he saw several humming-birds (*Loddigesia mirabilis*) approach a limb and alight just above his head. While watching them he observed them leave the perch, at the same time two of their tail feathers spreading out so that one extended upon one side, and one upon the other, and although in mid-air the birds still appeared as if they were on a perch, or were holding in their claws a feather. Instead of flying away they took positions in the air, one above and one below the branch, and there remained several minutes, rising and falling, and occasionally changing places when they would return to the branch to rest, then continuing the curious performance which the naturalist was convinced was some game. As the tiny creatures poised they resembled gems of dazzling appearance. The crests were a vivid sapphire blue, changing in different lights to various shades of violet; the breast feathers were a golden green, while about the feet were ruffles of pure white.

As a rule the cranes and herons are the most dignified of all the bird-creation, especially when observed in the haunts of their choice — generally the desolate marsh where the approach of an enemy can be readily seen. Here they stand motionless, resting on one leg, either asleep or engaged in deluding some unfortunate fish into the belief that they are, or with their fiery eyes fixed upon the water below. The heron or crane is not always the solemn creature it thus represents itself to be. When numbers of them gather together upon some sandy point, especially on moonlight nights, a perfect transformation occurs. They leap in the air, hop over one another's backs, contorting their long necks, pecking at imaginary enemies in mid-air, then alight and stalk up and down with mincing tread. Sometimes a number of birds will remain motionless while one will perform, and then, as if eager to join the dance, the entire party will leap forward, and a scene ensue laughable in the extreme.

The cranes of other countries indulge in games even more grotesque than those described. The

dances of the demoiselle or Numidian crane (*Antropoides virgo*) are thus described by the Russian naturalist, Prof. Von Nordmann :

"They arrive in the south of Russia about the beginning of March, in flocks of between two and three hundred individuals. Arrived at the end of their journey, the flocks keep together for some time, and even when they have dispersed in couples, they re-assemble every morning and evening, preferring in warm weather to exercise themselves together, and amuse themselves by dancing. For this purpose they choose a convenient place, generally the flat shore of a stream. There they place themselves in a line, or in many rows, and begin their games and extraordinary dances, which are not a little surprising to the spectator, and of which the account would be considered fabulous were it not attested by men worthy of belief. They dance and jump around each other, bowing in a burlesque manner, advancing their necks, raising the feathers of the neck-tufts, and half unfolding the wings. In the meantime another set are disputing, in a race, the prize for swiftness. Arrived at the winning-post they turn back, and walk slowly and with gravity; all the rest of the company saluting them with reiterated cries, inclinations of the head, and other demonstrations which are reciprocated. After having done this for some time, they all rise in the air, where, slowly sailing, they describe circles, like the swan and other cranes."

It would be difficult to find a more demure bird than the cock-of-the-rock (*Rupicola*) of South

America. It is a little smaller than a good-sized pigeon; the males are of a rich bright orange, with plume-like headdresses, and so beautiful withal that a former emperor of Brazil had a state robe made from the skins. The female bird has a dark-brown suit, and is not so attractive. The birds are timid, and it is difficult to approach them; their nests being formed up near the rocky beds of streams in inaccessible places. A naturalist succeeded in stealing upon a flock, however, and observed what might be termed a "bird-circus." The group consisted of eight or ten birds, standing upon a large rock in a ring several feet in diameter. All the birds faced the center, and were evidently watching the performance with the greatest interest. The entertainer of this feathered audience was a single bird which stood in the center. Extremely sedate in all its actions, it moved about, lifting its claws as high as possible, bowing its head, and spreading its tail, thus displaying the black markings, marching around in a circle, leaping solemnly in the air, and going through a variety of ludicrous manœuvres. After the bird seemed

to have exhausted its powers as a contortionist, it retired and took its place among the spectators, another bird or actor stepping into the ring, and evidently striving to exceed the other in the eccentricity of its motions. Now some imaginary enemy was attacked, and violent pecks and wing-strikes made at the empty air, the performer wheeling about, darting quickly this way and that as if avoiding the adversary's blows until, exhausted, it fell back into the line giving way to a fresh performer.

The games of many birds are aerial, and present grand spectacles, wonderful exhibitions of flight. Such, for instance, are the evolutions of the great English bustard, whose rushes and movements in mid-air are extremely remarkable for so heavy a bird. Rising upward, as if intending to leave a certain locality, it suddenly swoops down with the velocity of a hawk darting upon its prey. Down it comes, the wind whistling about its wings. A second more, and it will strike the ground, but suddenly its wings are spread and its headway is stopped. Then begin a series of contortions and movement, that defy description. The great bird

seems poised by some other agency than its wings, so strangely are they employed. Finally when thoroughly exhausted, it alights and joins its comrades who have been interested observers of the performance.

In all these instances there has been no special place selected as a playground, any locality suiting the purpose; but by a number of birds found in Australia playgrounds are built with as much care as those intended for human use. One of the most interesting of these playhouse-makers is known as the *Ptilonorhynchus holosericeus*, and its actions have been carefully observed by Mr. Coxen, of Brisbane, New South Wales, and a specimen of their playhouses placed by him in the Natural History Museum at Sydney. In the erection of its house the bird displays great care. A level spot is selected, well-concealed, and in a locality free from interruption. Then a number of twigs are taken and placed upon the ground in parallel rows, and then carefully interwoven; this forms the flooring. Other twigs are now collected, of a little finer quality, and these are inserted in the sides of the plat-

form, the tops being pushed together so that they join and form the apex of a roof. These thatches are skillfully woven in and out, until the roof is secure and in some cases water-tight. The arbor or hall so formed is from two and a half to three feet in length. The bird then proceeds to furnish the house with toys. These are bright objects of all kinds: gaudy shells of snails, bright feathers, bits of colored glass found near camps, brilliant insects; in short, anything of an attractive nature. These playthings or ornaments are distributed about the floor, some hung upon the branches, and when all is arranged the collector invites its mate into the arbor or hall, and the birds amuse themselves by picking up the toys and changing them about, and by running in and out. This playroom is in a different locality from the nest, and should not be confused with it.

Some years ago several specimens of the satin bower-bird were brought from Australia and exhibited in the London Zoölogical Garden where they afforded much entertainment and amusement by their strange actions. Dr. Sclater says:

"Long before the construction of their nest, and independently of it, these birds form with twigs, skillfully put together and firmly planted in a platform of various materials, an arbor-like gallery of uncertain length in which they amuse themselves with the most active glee. They pursue each other through it; they make attitudes to each other, the males setting their feathers in the most grotesque manner, and making as many bows as a cavalier in a minuet. The architecture of the bower is exceedingly tasteful, and the ornamentation of the platform on which it stands is an object of constant solicitude to the birds. Scarcely a day passes without some fresh arrangement of the shells, feathers, bones, and other decorative materials, which they bring from long distances in the bush for this purpose. With the same object they immediately appropriate every suitable fragment placed within their reach when in confinement."

In one of these playhouses, in the Museum of Comparative Zoölogy at Cambridge, England, of these *Chlamydodera nuchalis*, the decorations or toys alone amount to half a peck of material, composed mostly of a large white univalve, the shell of a land snail, in all about four hundred of them; the rest being shiny flints, agates, highly-colored seeds and pods, bleached bones, etc.

The bower or playhouse of *C. maculata* is often four feet in length and two in width. In this case

no floor is made, the twigs being merely thrust into the ground in a regular row opposite each other, and allowed to fall together at the top.

The Quiscalus or Sanata, a bird resembling the magpie, found in Central America, has if not a sense of humor something very much akin to it. At certain times a number will meet and perform for the edification of others, dances, and games of a very entertaining nature. At one moment they will stand twisting their necks into seemingly impossible positions, ruffling their feathers, then walking slowly ahead, stopping suddenly and tipping the long tail up so that it almost strikes the head, conveying the impression to the observer that the performer had suddenly realized that its movements were not exactly dignified. These bird antics are often seen on the tops of houses.

The ants, which many authorities, notably Sir John Lubbock, rank next to man in point of intelligence, though extremely busy and hard-working little creatures, have their times of relaxation, and have been seen by close observers engaged in performances which were undoubtedly games. Hu-

ber says of scenes on the surface of ant-hills: "I dare not qualify them with the title gymnastic, although they bear a close resemblance to scenes of the kind." The ants observed by this naturalist raised themselves on their hind legs, caressed each other with their antennæ, and appeared to be engaged in a mock battle, and anon "hide-and-seek"; every movement, however, being conducted without any evidence of rage which passion, it is needless to say, is easily recognized in the ant.

Huber's suggestion that these actions were true games has been confirmed by Forel, a careful observer, who witnessed such remarkable games that he says it would seem almost imaginary if he had not seen them himself. Bates observed behavior in the ant *Eciton legionis* which he says looked to him like "simple indulgence in idle amusement," and the conclusion, he adds, "that the ants were engaged merely in play was irresistible."

Any one who has observed ants carefully in this country must have seen something of the kind, and that they are fine gymnasts there is no doubt, as such feats as swinging from a twig by their last

pair of legs, and standing on their hind legs, are often noticed.

So through all animal life we shall find that the various members have hours of relaxation, in which games and sports are the natural outcome.

CHAPTER XII.

GIANTS.

LONG ago and in fact in almost every period of human history we find references to giants, supposed human beings of enormous size; and so complete and serious are the discussions and measurements in many of the old histories and scientific works that there can be no doubt as to the good faith of the writers. In the tenth, eleventh, and twelfth centuries some of the most important controversies among the wise men were in relation to these "finds" or discoveries, which,

it is needless to say, were not what they were supposed to be — though certainly giants.

About the middle of the eleventh century the scientific world of Europe was thrown into great excitement by the report that the body of Pallas, the son of Evander, had been discovered under the tomb of the Emperor Henry III. The bones were of immense size, and the finders conjectured that if placed together the figure would stand as high as the walls of Rome. This story was received by the incredulous; but later the remains were shown to be those of a fossil elephant — a giant indeed, but not a human one.

In the fifteenth century numbers of fossil elephants were discovered, which, with hardly an exception, were considered giants; and one excavated in Dauphiné, during the reign of Louis XIII., caused more controversy than any subject, political or scientific, of the time. All classes of scientific men were arrayed against each other; the two parties being divided as to whether the bones were those of an elephant or the giant Teutobochus.

Later in 1577, the inhabitants of Lucerne, Swit-

zerland, announced to the world that a giant had been discovered in their precincts. The announcement was made by a distinguished man of science, Professor Felix Pläter of Bâsle, who examined the remains by order of the council, and reported as above; and forthwith the eminent professor was requested to make a design of the giant restored, which he did, giving the figure of a man about twenty feet in height, and this the proud populace adopted to support the arms of their city. The design and some of the bones can still be seen in the college of Jesuits at Lucerne. But when Blumenbach examined the bones he immediately pronounced them those of an elephant, much to the mortification of some, while others held out for the giant.

Even in America when the first mastodon and fossil elephant bones were unearthed they were thought to be those of giants; but a race of human giants never existed, the so-called ones being only exceptionally tall men of seven feet and some inches.

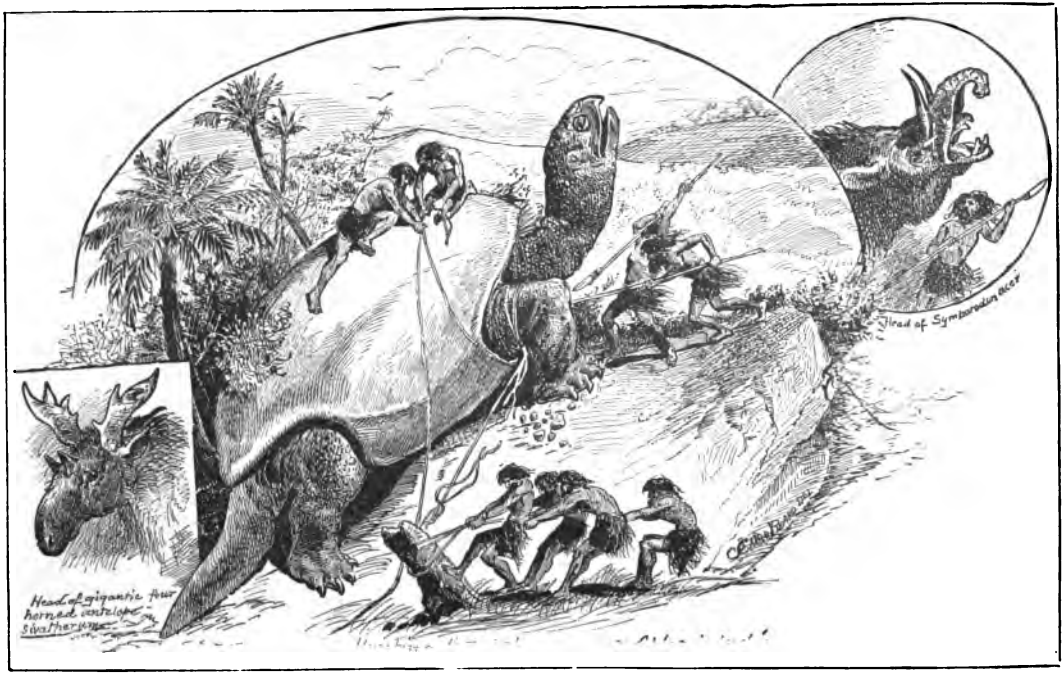
The ancient days of the world's history were

preëminently the days of giants; life in what is known as the cretaceous, or chalk age, attaining a remarkable development. Some of the animals were so large that it is difficult to see how they moved about with agility sufficient to preserve them from foes, and if man existed at this time, he was confronted with many creatures compared to which the largest land animals of to-day are mere pigmies.

Several years ago some laborers were engaged at a work which required excavations, in the Sewalik Hills of India, when they came upon the remains of an animal of remarkable size and structure. By carefully removing the soil they exposed what might have been used as a hut for a dozen or twenty men, and which proved to be the shell of an enormous extinct land-turtle. It was taken out with great care, and after a while carried to England, where a perfect restoration may now be seen in the British Museum. Its dimensions were as follows: length ten feet, horizontal circumference twenty-five feet, and girth in a vertical direction fifteen feet.

But this was a young turtle, a baby, so to speak, gigantic as it was, and one third less than a larger specimen, which we may picture as a monster crawling slowly over the ground; its enormous dome-like back, when raised on the stupendous legs, eight or nine feet from the surface, its foot-prints in the soil as large as those of a rhinoceros; some authorities give its total length, when restored, as twenty feet.

Such a huge slow creature must have been comparatively helpless, and have fallen as sure prey to the primeval hunter who, though armed with only stone axes and rude weapons, could destroy it and use the shell as a house for his family. The scene of such a capture may well have been an exciting one; even though the monster was comparatively harmless its great strength must have enabled it to make considerable resistance in attempting to escape. Fancy a score of men mounted upon its dome-like shell; and vines, or ropes perhaps, used to retard the creature's movements, and thus harassed, belabored by the heavy stone hammers about the head, pounded by the



SOME OF THE GIANTS.

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agile men upon its back, the great beast pushing sturdily on, crushing small trees and bushes in its way, sweeping off its enemies, while others follow with loud shouts, until finally completely entangled, it draws in its powerful legs and falls to the ground, awaiting its fate after the manner of the giant Galapagos turtle of to-day. With the rude appliances of such an early time the *Colossochelys Atlas*, as it is called, even now would seem comparatively safe with its feet and head drawn partly into its shell; but the lowest native tribes of to-day almost invariably devise some method for slaying the larger animals, and these early hunters, if there were men at that time, would probably have been no exception.

A party of workmen, some years since, were blasting in a quarry at Rock Hill, near Maidstone, England. The material was limestone, and among the pieces that came off after a blast, the overseer noticed a section which resembled petrified wood. Having an unusual appearance it was taken to a scientific man, who pronounced it a part of the skeleton of some gigantic animal. The labor-

ers were directed to remove the specimen with great care, and the result was the collection of the remains of one of the most remarkable creatures of ancient times. It was the Iguanodon, a giant representative of the little lizard iguana now found in the South American country, a harmless creature rarely exceeding two or three feet in length. Its extinct relative was quite another affair. In bulk it would have equalled three animals as large, perhaps, as the lamented Jumbo. It stood like a kangaroo upon its colossal hind legs, and rested upon a tail of massive proportions. When standing thus, and gnawing from the trees of its choice, its head must have been fourteen or fifteen feet from the ground; and the total length nearly thirty feet.

Imagine such an animal in England to-day! for in former years it wandered about what are now the streets of London, grazing upon and tearing down the large trees of the time, and grinding them with its curious teeth which had serrated edges like those of a shark. Like the huge turtles this giant was a slow mover, and would have been easy prey for mesozoic hunters with javelins and arrows.

Almost equally large and much more ferocious was the Megalosaurus, which, instead of being a plant eater was carnivorous, and preyed upon other animals, and must have been a fierce and formidable foe.

While Europe has produced some remarkable giants, America leads in this respect, and in the early days was peopled by races so astonishing, that all the dragons and fanciful monsters which the vivid imaginations of the writers of old have pictured, fail to compare with the actual reality. In fact, if it were desired to-day to produce a book of wonders and marvels, describing the dragons and other terrifying creatures, it would be only necessary for the historian to refer to the geological discoveries of the last thirty years, and represent the animals just as they were. What was the dragon of St. George to certain huge bat-forms, or the unicorn to the Loxolophodon with its many horns? The roc of the Arabian Nights was not more wonderful than some of the fossil birds, and even the great Poulpes of the grave Bishop Pontoppidan, seem almost equalled by the giant

squids of to-day, some of which are fifty or sixty feet in length. In short, the imagination of man cannot picture wonders to compare with the actual creatures which have peopled the globe in former ages.

In the geological hall of the Museum of Natural History, Central Park, there is upon one of the shelves an object about five feet and a half in length, extremely bulky, and weighing so many pounds that two men find it all they desire to carry. It is of a brown hue, and might be taken for the trunk of a fossil tree or part of a huge branch. At its side lies a small white bone four or five inches long, with a label to the effect that it is the corresponding bone of a living crocodile. In fact, the great brown mass, as bulky as a large man stretched at full length, is the thigh or hip bone of an American giant, which in former years roamed the great cretaceous sea of the West. The largest crocodile of to-day is about twenty feet in length, and its thigh bone four or five inches. If the thigh bone of the Atlantosaurus, of which this is a part, be six feet long — and Professor Marsh

has discovered one eight feet in length — how long must its possessor have been? This is an example in proportion, which will admit of widely different answers perhaps; but while my readers are guessing I will say that geologists believe these giants to have attained a length of from eighty to one hundred and twenty feet. While they have been likened to crocodiles they differ entirely from them in appearance, having long legs, an attenuated tail and neck, and a small head; giants of wonderful structure, living in the shallow waters of the great seas of the time, floating perhaps, or anchored by their prodigious feet and tail.

These colossal saurians were a common feature of the life in the Jurassic days, when a vast sea covered Kansas and most of the Western States. The *Amphicoelias fragillisimus*, described by Professor Cope, was from eighty to one hundred feet in length, and the *Camarasaurus supremus* attained a length of seventy-five feet. Thus there were in those days animals longer than the present whales, which crawled about upon the beaches and shores of the ancient seas.

If man existed at the time — and we have no evidence that he did, except that the climatic and other conditions would have permitted it — he found wondrous game indeed; and to have followed these mighty creatures in rude crafts and attack them with crude weapons, would have been a daring feat. An animal which was equally at home on land and sea; which could sweep a large area with its enormous tail, dive into the greater depths with great velocity, and while its body was far below watch its prey, extending its neck upward, was certainly game worthy the name.

These huge monsters were undoubtedly harmless if undisturbed, their only method of defence being the tail, which, like that of the crocodile, could probably be hurled about with great force.

The fact that many of these giants were practically defenceless is somewhat remarkable, and this is particularly noticeable in one of the Dinosaurian reptiles of the mesozoic era, described by Professor Marsh, of Yale. Its dimensions were colossal, and its weight many tons; yet its head was astonishingly small.

The *Brontosaurus excelsio*, as it is called by its discoverer, possessed a body of elephantine proportions, to which was attached the long attenuated tail of a crocodile, while the head and neck call to mind that of a serpent, added as though to produce an unnatural contrast. This strange giant was a water-loving reptile; probably drifting about like the hippopotamus, perhaps occasionally lifting itself on its hind legs which were much larger than the others; but how so huge a creature could sufficiently supply itself with food having such a small mouth, is somewhat of a mystery.

The sea in which some of these huge Dinosaurians lived was of vast extent. The rising of the crust caused it to become shallow, and it finally resulted in mud-flats, entombing the giants whose bones now rest under fields of growing grain, or are exposed by the winds that weather them out in the Bad Lands.

The mammals, or milk-giving animals, of a later time were no less remarkable. In the Tertiary period the space from the Missouri River to Eastern Wyoming and Colorado was an extensive lake

or lakes, and the sights to be seen must have been more astonishing than any to be observed in Africa at the present day. There were primitive camels (*Poëbrotherium*), strange hog-like animals, the Oreodon, and another remarkable form, the Elotherium. But strangest of all were those colossal beasts as large as our Indian elephants, but with shorter limbs like the rhinoceros, having four toes in front and three behind. In one, the Symborodon, the head was very long, and armed with two long sharp stout bony protuberances.

Preying upon these animals and others were American hyenas, with dog-like characteristics and a terrible array of teeth; dogs, cats, tigers, and panthers of more or less ferocious aspect; remains of which are found in vast numbers on the borders and in the bed of these ancient lakes, known now as the White River formation.

About this time in the region of the Himalaya Mountains, a wonderful giant was roaming about; a creature as large as an elephant, covered with thick shaggy hair, which upon the neck, above and beneath, formed a heavy mane. Its muzzle was

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large and wide; its feet hoofed, while from the head rose two pairs of horns; the front ones being straight and resembling those of the rhinoceros, though side by side, the rear pair were large, branching, and curved, giving the animal a ferocious appearance. This giant must have been formidable, and capable of defending itself from the largest beasts of prey. It was related to the antelopes and giraffes, and known to science to-day as the Sivatherium.

When the famous phosphate beds were discovered in South Carolina some years ago, vast numbers of bones and teeth were unearthed, showing that in early times this locality had been peopled by a great concourse of strange forms. Among the most abundant curiosities, as the workmen termed them, were quantities of enormous teeth triangular in shape, and serrated on the cutting edge. When shown to a naturalist they were immediately recognized as shark-teeth, and it became evident that at one time the locality in the vicinity of Charleston was the bed of an ocean, and that gigantic sharks flourished there in great numbers.

Whenever the beds of the Ashley and Cooper Rivers are dredged to-day numbers of these teeth are brought up, and one in my collection is nearly if not quite as large as my hand. As the bones of the shark are of cartilage, they have long since been destroyed, and only these beautifully polished teeth — for they are as fresh and glistening as when first discovered — are left to tell the story. It would appear to be an impossible task to restore this giant from a single tooth. But it is not so difficult as one might imagine. From the shape of the tooth of the great Charcharodon we can form some idea of its appearance by comparing it with existing sharks, and from its size we can determine how large it was. One day I attempted a rough restoration to gain some idea of the dimensions of the giant. I had in my possession the jaw of a shark which I had caught in the Gulf of Mexico, which would at the time pass readily over my shoulders. The shark was about thirteen feet long, and the teeth about an inch and two eighths wide, and an inch and a half in length. There were eight rows of these, each row being a little smaller than

the last, until they dwindled down to mere points. I took as many of the fossil teeth as I had, and built up a jaw after the existing model, using teeth where I had them and leaving space where I did not. Gradually the great mouth grew on the floor until I found myself a small item in the area, and when completed I found that the largest fossil shark could have opened its mouth and allowed me to drive in a top-buggy, and that its length could not have been less in proportion than one hundred and twenty-five or thirty feet. The largest existing allied shark is the great Carcharias Rondelletti, found in Australian waters, just one hundred feet less, there being a jaw of a specimen in the British Museum from one that measured thirty feet in length.

The Rhinodon, a huge creature that feeds on small pelagic animals, attains to-day a length of sixty feet, and our common basking shark, I have been informed by reliable persons, attains a length of fifty feet.

Among the marine giants of to-day, the Japanese crab, *Macrocheira*, deserve mention on account

of being the most remarkable of living crustaceans as regards size. It is an ally of what in America we commonly call spider crabs; the forms whose diminutive bodies and attenuated limbs so mimic the rocks among which they hide. The Japanese crabs resemble them except in size; the body appearing like a rock, so rough and irregular is its surface, and undoubtedly the animal is protected by this mimicry. In the Museum of Comparative Zoölogy in Cambridge, there is a fine perfect specimen though small, and not conveying an adequate idea of the largest specimens, one of which measured twenty-two feet from the tip of one claw to that of the other. They are comparatively common on the shores of Japan, and Prof. Ward, who has collected them, informed me that they have a curious habit of leaving the water in the bays, and crawling upon the shores at night, presumably in search of food.

The largest fossil crustacean ever found did not present so formidable an appearance as the Japanese crab, though it possessed a larger body. It was a Pterogotus, a creature somewhat resembling a scorpion, and attained a length of nine feet.

While I have not intended to allude to the large living animals which might be called giants, I cannot pass by a very interesting one which was first observed by Professor and Mrs. Agassiz off Nahant. It was one of the largest invertebrate animals ever seen — a gigantic jelly-fish, above five feet across the disk, with tentacles trailing after it one hundred and twelve feet in length. A much larger specimen is reported by Mr. Telfair, an English naturalist, as having been seen off Bombay. It was estimated that the tentacles were three hundred feet in length, and that the animal weighed several tons — a giant indeed when compared to the delicate forms with which the beaches of the New England coast are now dotted.

While the great four-horned antelope previously described was wandering on the plains of Asia, a remarkable elk was living in Ireland, probably as green and fair a grazing ground as to-day. It was of commanding stature, being nearly ten feet in height from the top of its antlers to the ground. Nearly all the specimens found are taken from the bog, and discovered accidentally in digging

out this material so valuable to the poor people. A fine specimen changed to a dark mahogany color from its long contact with the soil, may be seen in the Museum of Natural History, Central Park, and its horns are so large and spreading that a dozen people could perch upon them, and were the great elk alive little inconvenience it in point of weight.

The days of the giants seem to have passed away, the whales, the great basking shark, the elephants, and a few other forms, some doomed to extinction, alone remaining to excite our wonder at their colossal proportions.

CHAPTER XIII.

FEATHERED GIANTS.

IN studying the history of any of the living animals, domestic or otherwise, we find that in almost every case we can trace their ancestry directly, or indirectly, to a line of giants.

In fact, there seems to have been a period in the early history of our world when nearly all animals were much larger than at present. There were antelopes as great as the largest elephants; an elk upon whose horns twenty or more boys and girls could have been carried; the elephants were one or two times larger than they are now; the little lizard, Iguana of South America, was represented by an enormous creature, the Iguanodon, twenty feet or more in length, and powerful enough to tear down large trees; the lions, tigers, bears, kangaroos — in fact, nearly all the animals — were giants.

We should hardly expect to find this applying to the birds: the great ostrich and others seem almost giants themselves. Yet within the days of the earliest man there existed birds compared to which some of our largest living friends are pigmies.

The home of some of these Feathered Wonders was in New Zealand, a land that has produced many strange and curious creatures, living and extinct. The first information concerning the birds was obtained from the natives and their tales and traditions. They told the Englishmen who ventured among them that the ancient Maori were powerful people and the earliest owners of the New Zealand country. Their traditions described them as great hunters, famous for their deeds of prowess and personal bravery, and among the dangerous animals that they pursued and destroyed for the sake of the wonderful feathers, was a gigantic bird that was twice as high as the tallest chief, and that was larger, stouter, and stronger, than any other animal they had to cope with. So powerful indeed were the great birds, that only the bravest

men attacked them, and their feathers were worn only by prominent chiefs, the possession being a distinction that corresponds to the decorations given to brave warriors at the present day.

Not only were the feathers valued by the ancient Maori, but the flesh was eaten, and the bones made into fish-hooks, and weapons of various kinds. In the songs of the natives the name of the Moa often occurs, and in fact so much was heard of this feathered giant that the naturalists thought possibly there might be some truth in it, and immediately began investigations that resulted in finding the remains of the great birds.

It was shown that about five hundred years ago these birds flourished on the different islands in great numbers, being finally exterminated by the Maori, although there are some who believe that the great creatures still live in the high mountain-lands of the interior. The greater number of the most perfect skeletons were discovered in caves. In explanation of this the natives said, that according to their traditions the country was consumed by fire from the volcano of Tongariro, and that the

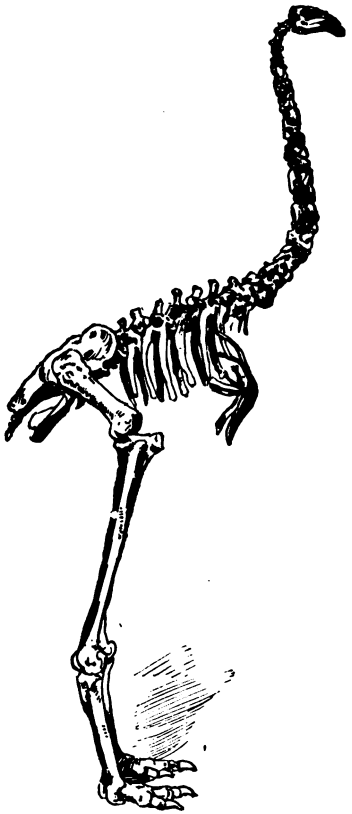
birds being thus driven to the caves were there imprisoned. Many, however, died a natural death, or were killed by a change in the climate.

One of the largest deposits was found in a swamp. Upon the peat being removed many tons of the bones of the gigantic birds were exposed, and it would seem that here the unwieldy creatures had fled to escape their enemies, either man or beast.

In appearance the Moas were huge impressive creatures, the largest being over thirteen feet in height, with rudimentary or no wings; its legs appeared more like great columns for support than organs for locomotion, and the bones themselves were larger than those of an ox.

Such powerful animals could not have submitted tamely to capture; and while the Maori legends hint at the danger of the chase, we can well imagine that it was only after a fierce struggle that the great game gave up.

If in flocks, their very rushing along would have been a wonderful sight, and few animals could have withstood the charge. The pressure of the great feet would have killed a human being, and if in-



SKELETON OF A FEATHERED GIANT, DINORNIS MAXIMUS.

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clined to strike with this organ like our present ostrich, they would indeed have been antagonists to be dreaded.

In some localities the eggs are found, and in one spot a number of them were grouped together,

THE LARGEST BIRDS'-NEST IN THE WORLD.
(*Eggs of Æpyornis maximus, Madagascar. Each egg equalled about one hundred and fifty hen's eggs.*)

suggesting that perhaps there had been a nest of the huge creatures and that from some cause they

had been led to desert it. Single eggs are often found in the caves, burnt and charred, showing

HUNTING THE GIANT OF THE MAURITIUS.

(*Legnatia gigantea, seven feet high and wingless. Last seen at Mascarene Islands in* 1694.)

that probably they formed a part of the food of the ancient tribes.

Although the Moa eggs are much larger than any known at the present day, they are dwarfed by the eggs of a feathered giant that once lived on the island of Madagascar. Several years ago, the captain of a trading vessel made his way up a shallow river that found its way down to the sea at the southern extremity of the island, and there fell in

CAVE MEN CAPTURING THE GASTORNIS EDWARDSII.
(Gigantic goose-like bird with teeth and thirteen feet high. Rheims, France.)

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with some native tribes that rarely mingled with new-comers or whites. Among the many curious objects noticed by the captain and his men about the native village, were some dishes that were used to hold water and food of various kinds. They held about a gallon of liquid, and were round at the ends, so that they had to be propped up. The captain asked why they did not make them with bottoms so that they would stand alone, when to his astonishment he was informed that the vases were not made by them, but were eggs. They were enormous shells, capable when perfect, of holding over two gallons of water, or, equal by exact measurement to one hundred and fifty hen's eggs.

From the owners the captain learned that the eggs came from a locality not far distant, and an expedition was formed later that resulted in the finding not only of the eggs, but of the remains of four distinct species of the enormous birds, buried in vast sand heaps that had perhaps blown over them and their nests. Natives were hired, and large trenches dug in various directions that exposed many of the bones.

In one spot, a great number of eggs were uncovered but they were mostly broken; their being grouped together, however, pointed to the belief that here was the nest of the great Æpyornis, probably the largest bird's nest in the world. The sand was carefully worked away and the great shells exposed, but nearly all were damaged or cracked, and the sand had drifted into them making one a good load for one man. But the nest was soon robbed, the workmen marching off with the finds upon their shoulders to deposit them in a place of safety. Perfect ones in this country are extremely rare, and are valued at about three hundred dollars apiece.

If the Moas were considered dangerous to attack, what must have been the aspect of this huge creature when at bay? If they were hunted by early man we can well imagine that strategy instead of open chase must have been the method of capture. Perhaps pitfalls were dug, and the great game driven into them where they were destroyed by the rude stone clubs and spears of the natives.

The strange tale of the Roc, told in the *Arabian*

SKELETON OF A FEATHERED GIANT, THE PALAPTERYX CRASSUS.

Nights, is supposed to have been taken from a legend of this gigantic bird.

When the first discoverers of the Mascarene Islands investigated that locality, they found among other strange animals a number of huge birds without wings, which, however, were remarkable for their power of running. One was a rail, that stood a foot higher than the tallest man, being over seven feet in height. The bird was so beautiful and curious that the sailors followed it whenever an opportunity offered, and the natives finding that they could readily use them in barter also began what resulted in a war of extermination. The poor birds were pursued by the hunters day and night, hedging them in, and chasing them through swamp and forest until they were finally brought to bay, and after a struggle reduced to subjection.

A few years of such incessant hunting greatly lessened their numbers, and finally they were entirely destroyed, the last one having been observed in 1694, only one hundred and ninety years ago, yet to-day not a single bone or feather remains to tell the story of this giant among its kind.

Among the other curious birds of this and other islands, was the giant of the pigeons, a bird as large as a swan; an immense pigeon with fluffy, curly feathers, but incapable of flight. When Mauritius was discovered in the sixteenth century, this bird was common, and was killed by the sailors in great numbers; by some in wanton sport, and by others for the curious stones they found in its stomach. It was so effectually hunted by all, that it soon ceased to exist, and was driven literally from the face of the earth The last living one was seen by the mate of the English ship *Berkley Castle* in June, 1681, and to-day not a single specimen of the great bird is known. A foot in the British Museum, a head and foot at Oxford, and a few other bones, are the only relics to tell the story of the existence of the king of the pigeons, the famous Dodo.

Many centuries ago in France when man lived in caves, if at all, there lived a gigantic bird called the Gastornis, a great goose-like form that towered aloft thirteen or fourteen feet, and was a most powerful creature. It probably lived near the

streams in marshy spots, and depended upon its powers of running to escape its enemies, as it had no wings. About the locality where the city of Rheims now stands, the remains of this great wader and swimmer have been found in the caves mixed in among the bones of other animals, as the great mammoth and cave bear, that are known to have lived during the time of man, by whom they were undoubtedly hunted and used as food.

But these were not the greatest of the giants of this olden time. The largest of the wingless birds, as we have seen, was the great Moa, whose plumes were worn by the victorious Maori chiefs, but even these had feathered enemies — enormous eagles or birds of prey, as the Harpagornis, large and powerful enough to have borne the largest of the Dinornis tribe off through the air to its nest. Surely the Roc, as it is pictured by the old Arabian story-tellers bearing Sinbad away, is not so much of an exaggeration after all, as if the Harpagornis could make the Moa its prey it could easily have borne away several human beings.

Another giant was a huge goose called by the

naturalists Cremiornis; while others of less stature though gigantic when compared to their living representatives, have left their remains in caves and various deposits, speaking monuments of their greatness and of the age of wonders in which they lived.

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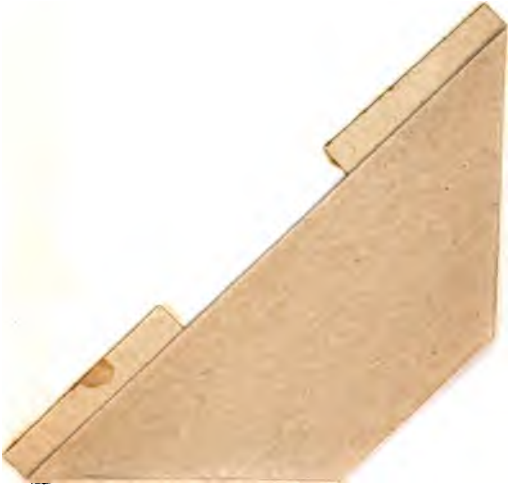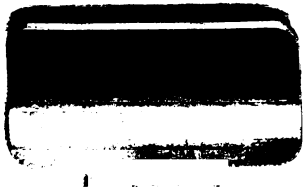
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